DRAFT ENVIRONMENTAL IMPACT REPORT

SAN JOSE ARENA FACILITY

SAN JOSE, CALIFORNIA

LEAD AGENCY:

THE CITY OF SAN JOSE

SCH NO. 87042128

EIR APPENDICES

VOL. II OF II

AUGUST 1987

APPENDIX A

TECHNICAL REPORTS

SAN JOSE ARENA FACILITY

SITE A

SAN JOSE, CALIFORNIA

APPENDIX A-1

TRAFFIC AND CIRCULATION ANALYSIS

BARTON - ASCHMAN ASSOCIATES, INCORPORATED

SAN JOSE, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

SAN JOSE ARENA FACILITY
TRAFFIC & PARKING
IMPACT STUDY
FOR SITE "A"

Prepared For:

THE REDEVELOPMENT AGENCY OF THE CITY OF SAN JOSE

Prepared By:

Barton-Aschman Associates, Inc.
July 1987

SAN JOSE ARENA FACILITY

TRAFFIC & PARKING

IMPACT STUDY

FOR SITE A

Prepared For:

The Redevelopment Agency of
The City of San Jose

Prepared By:

Barton-Aschman Associates, Inc.

July 1987

23401515/TS/Site A:87364

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

LIST OF TABLES

LIST OF FIGURES

1.

INTRODUCTION

The City of San Jose is considering the construction of an arena facility for indoor sporting events, entertainment, ice shows and concerts, and large meetings. The purpose of this report is to analyze the anticipated traffic, parking, pedestrians, and neighborhood impacts that would be created by a general-purpose indoor arena facility.

The proposed site is located in the vicinity of downtown San Jose: north of West Santa Clara Street, west of Los Gatos Creek/Guadalupe River, south of West Saint John Street/West Julian Street and east of the Southern Pacific railroad tracks (see Figure 1). Roadway access to the site would be available from West Santa Clara Street, West Julian Street, and Autumn Street.

For a comprehensive analysis of the potential impacts such a facility could have on the existing transportation infrastructure, five different time scenarios and two different seating capacities were considered in this study. The different time scenarios focused not only weekday evening events but also on Friday and Saturday evening events. One scenario investigated the impact of the arena on the PM peak hour commute traffic conditions. Another one dealt with the traffic conditions after the end of the arena events.

Two different attendance levels were considered in this study. While most of the events are expected to draw a maximum attendance level of 17,500 persons, it is anticipated that an attendance level of 20,000 persons may occur a few times a year.

The following chapters are sections on parking, traffic, pedestrian and neighborhood impacts. Each chapter discusses the existing conditions, outlines the assumptions used for the analysis and presents the findings and recommendations. Conclusions drawn from this study are provided in the last chapter of this report.

Barton-Aschman Associates, Inc.

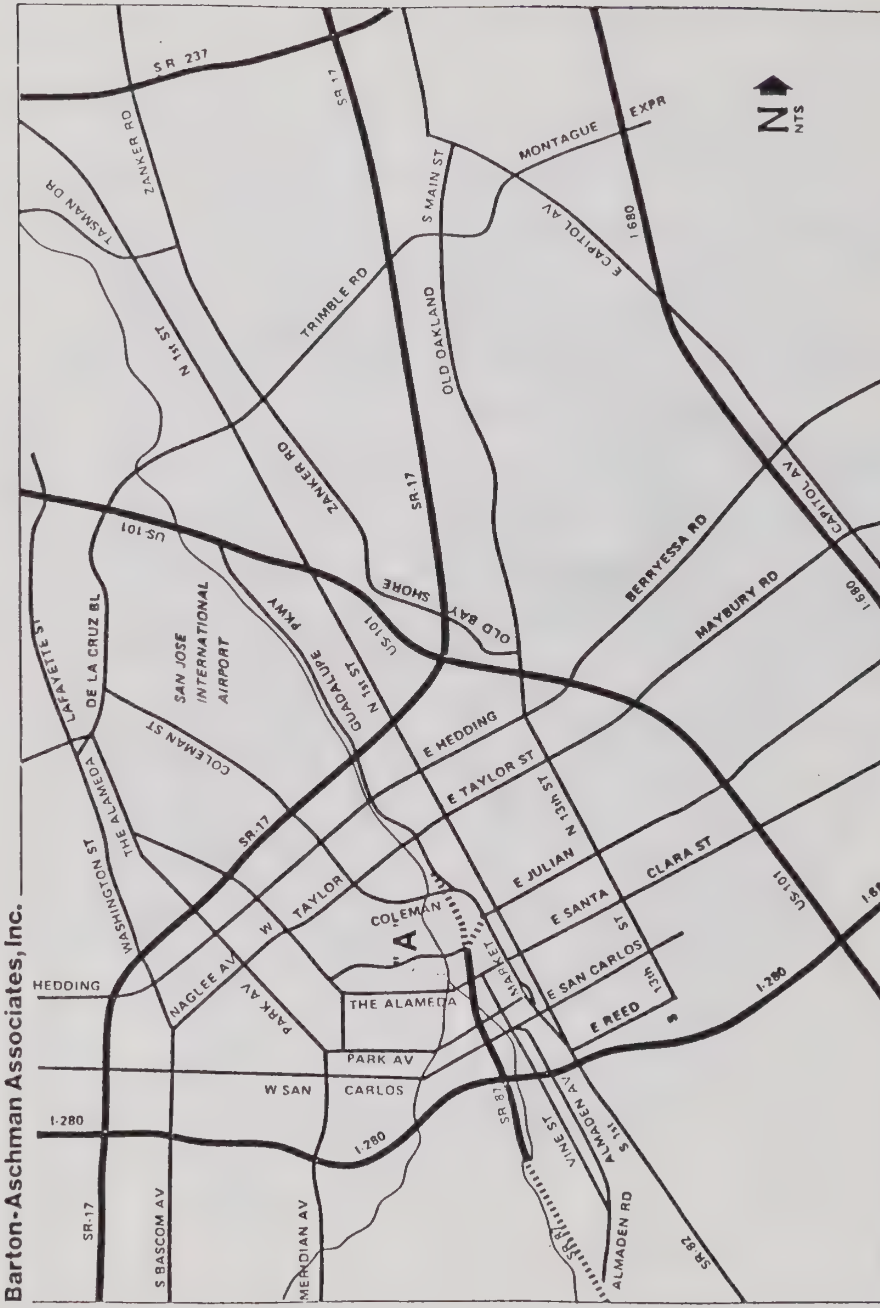


Figure-1
LOCATION OF ALTERNATIVE ARENA SITE "A"

2.
PARKING NEEDS AND SUPPLY

The parking demand characteristics of arenas vary greatly because of the differing type, attendance levels, and time of events. Also, the parking needs for arena events are influenced by the mode of arrival, the vehicle occupancy ratio, and the average and peak attendance levels.

The proposed arena on Site A is planned to accommodate different types of events. Each type of event would generate different parking demands. Broad categories of events would include professional sports, college sports, family shows, concerts, and community/convention functions.

This chapter summarizes the existing parking conditions, provides forecasts of parking demand with the arena, and discusses the provision of parking to serve the arena patron parking needs. Also, the alternative schemes pertaining to on-site parking are described in Section 2.3.

2.1 Existing Parking

A parking inventory and parking usage survey was conducted to assess the existing on-street and off-street available parking and utilization within 3,000 feet of Site A.

<u>On-Street Parking Inventory</u>

A parking inventory of the existing curbside (on-street) parking spaces was conducted in February 1987 for the study area. In the parking inventory the current parking restrictions were documented. There are nine different parking restrictions currently imposed on the available curbside spaces within the study area. The number of available parking spaces was identified for the curbs where parking is permitted. There exists a total number of 1,598 spaces, as indicated in Table 1. The on-street parking study area is shown in Figure 2.

<u>On-Street Usage</u>

A curbside on-street parking usage survey was conducted on a weekday in the evening period, between 7:30 PM and 8:30 PM. During the survey, all curbside spaces were visited, and the number of parked cars was counted. This survey provided information regarding the current demand for on-street parking in the evening.

On-street parking was analyzed by dividing the study area into nine zones, as shown in Figure 2. The on-street utilization is summarized in Table 1 for the evening period between 7:30 and 8:30 PM.

Barton-Aschman Associates, Inc.

Figure-2
ON-STREET PARKING
STUDY ZONE BOUNDARIES

TABLE 1
ON-STREET PARKING WEEKDAY EVENING UTILIZATION (7:30 to 8:30 PM)

Parking Zone	On-Street Spaces	Cars Parked	Percent Utilization
I	136	17	13%
II	225	57	25%
III	285	145	50%
IV	146	27	18%
V	200	35	18%
VI	134	23	17%
VII	145	69	48%
VIII	243	149	61%
IX	84	12	14%
TOTAL	1,598	534	33%

According to the parking utilization survey, Parking Zone VIII showed the highest usage of 61%. The next highest usage was in Zone III with 50% utilization. Zone V includes the area proposed for the arena. This zone had a low usage of 18%.

During the weekday evening period there is an overall usage of 33%. The evening parking is related to the existing land uses, and the highest utilization (61%) occurs in the commercial areas offering evening entertainment.

Off-Street Parking Inventory

The off-street parking inventory was conducted to determine the available parking spaces. These include the public and private surface lots and garages within 3,000 feet walking distance of Site A. Also included in the inventory are the future parking spaces that will be available in the next four or five years as a result of the construction of new buildings. These buildings are either under construction or approved for construction in the next few years.

The inventory listed in Table 2 shows that there are 6,073 existing off-street parking spaces. The additional 2,391 off-street spaces that are either under construction or approved for construction will bring the total number of spaces to 8,464.

Off-Street Usage

The parking usage survey for the existing parking facilities was conducted for the afternoon peak between 2 PM and 3 PM and Friday evening peak period between 6 PM and 9 PM.The afternoon peak period surveys showed that the existing garages were over 80% utilized by the tenants of the buildings. The Lincoln Property garage was not heavily used because the building was recently completed and is not fully occupied. Table 3 shows the parking space usage during the evening peak period.

TABLE 2
OFF-STREET PARKING INVENTORY

Description	Parking Spaces
Existing Facilities	
1. CalTrain Cahill Station	679
2. San Jose Water Company	372
3. Pacific Valley Bank Garage	700
4. Park Center Plaza II	302
5. Park Center Plaza III	1,220
6. Lincoln Property Building Garage	1,300
7. Market Street Garage	1,500
Total Number of Existing Spaces	6,073
Facilities Under Construction or Approved for Construction	
1. Parking Area Under Route 87	320
2. Boone Fox Building	873
3. William Wilson Building	715
4. Herron Building	483
Total Number of Proposed Spaces	2,391
GRAND TOTAL	8,464

TABLE 3
OFF-STREET PARKING USAGE

Garage	Spaces	# of Cars Parked During Evening Peak Period	Percentage Utilization
Park Center Plaza I	1,076	283	26%
Park Center Plaza II	302	322	107%
Park Center Plaza III	1,220	148	12%
Market Street Garage	1,500	185	12%

With the exception of the Park Center Plaza II facility, other off-street parking facilities surveyed have minimal usage during the evening period. This garage is in close proximity to the Center for Performing Arts. Therefore, it is over utilized (107%) with a number of cars parked illegally.

Summary of Conclusion

The neighborhood on-street parking surveys were conducted to understand the existing parking supply and demand conditions. This on-street parking is not used in the parking supply analysis. The purpose of the analysis is not to advocate the use of neighborhood streets for parking. It is intended to provide background information that emphasizes the importance of providing sufficient on-site and garage parking without the use of neighborhood street parking supply.

The existing parking facility usage surveys indicated that the parking space utilization for three of the four garages was very low, and that there are sufficient capacity available in the evening to accommodate some Arena parking needs. However, during the weekday afternoon most of the garages attached to the office buildings are utilized more than 80%.

2.2 Arena Parking Demand

The parking demand for an arena at Site A will depend on the mode of arrival, the vehicle occupancy of the arena patrons, the starting and ending time of the arena events, and the size of the anticipated arena facility. Following is a brief discussion of each of these elements as they apply to the site.

Travel Mode

Use of the private automobile as an arrival mode to the arena is largely dependent on the cost of parking, the available parking supply, and the existence of other convenient transportation alternatives for the arena patrons.

Due to the close proximity of the CalTrain Cahill station, seven County Transit bus routes operate within an acceptable walking distance of Site A. The introduction of express bus service at premium rates by County Transit and other neighboring transit agencies may be considered if an arena were built. Also, it is anticipated that a few of the arena patrons will use charter buses. The Caltrain Cahill station is within walking distance of Site A.

According to the current schedule, nine trains arrive at the Cahill Station between 6 and 8 PM on weekdays. These trains could serve events starting at or about 8 PM. For departures, just one train leaves at 10 PM. Depending on the demand another train could be added to serve late departures after 10 PM. The Light Rail station at First and Santa Clara Streets will be three-quarters of a mile away, which is beyond acceptable walking distance to Site A.

Based on the existing and potential bus and rail services the following percentages reflect potential transit usage by arena patrons for weekday evening events. Regular County Transit routes, express routes, and charter buses would carry an estimated 2% of the total attendance. CalTrain regular service would carry 5% of the Peninsula patrons residing in the U.S. 101 travel corridor.

Vehicle Occupancy

Vehicle occupancy for an arena varies by the type of event. For example, family shows, which attract many youngsters and senior citizens, normally have much higher person-per-car ratios than sporting or other events. In the past decade, the professional basketball games at the Oakland Coliseum averaged from 2.90 to 3.15 persons per vehicle. During the same period at the Coliseum, family shows ranged from 4.5 to 5.0 persons per car and concerts typically ranged between 3.5 and 4.0 persons per vehicle.

The firm of Coliseum Consultants is a member of the team for the study of alternative arena sites in San Jose. Based on their experience, the consultants recommend 3.0 persons per car as the average vehicle occupancy for this study. On the basis of this recommendation, a vehicle occupancy factor of 3.0 was adopted.

Peak Attendance Period

The attraction of people to events held at the proposed arena will depend largely on the patrons available leisure time. As a result, the majority of events will be held during evenings and on weekends to avoid conflicts with normal working hours.

Experience with other indoor arenas around the country has shown that most regularly scheduled professional sporting events are held on weekends and during weekday evenings. Certain other special events may have weekday show times although peak attendance usually occurs during evenings and on weekends. For this analysis, the parking demand was estimated for two time periods. The parking demand for the evening events was estimated based on the full capacity attendance for major events. The parking demand for afternoon events, consisting of family shows such as circuses and ice shows, was estimated for an average attendance level based on the experiences of other similar arena facilities around the country.

Arena Size

The proposed arena would be designed to host more than one type of attraction. Similar arenas are used for sporting events such as NBA basketball, ice hockey, professional boxing/wrestling, and tennis tournaments. In addition to the sporting events the arena would also host events not related to sports, for example concerts, ice shows, and circuses. For an arena facility intended for multiple uses, the regular event generating the largest parking demand should be the basis for determining parking provisions. For example, NBA basketball is considered to be an event that would occur with regularity.

The other important factor that should be considered in planning parking for an arena is the maximum seating capacity. In this study, two alternative seating capacities are being analyzed. The first alternative would provide 17,500 seats; the second alternative would provide 20,000 seats.

Parking Demand Estimates

The parking demand estimates for the 17,500 and 20,000 seats arena alternatives for evening full capacity attendance are shown in Table 4. The 17,500 seat arena would need 5,620 parking spaces either at the arena site or within a reasonable

walking distance. Similarly, the 20,000 seat arena would require 6,430. Weekday afternoon matinee events would occur about 20 times a year. The average attendance for these afternoon events would be between 10,000 and 12,000 persons.[1] The matinee events would require 2,610 parking spaces.

TABLE 4
ARENA PATRONS MODE OF ARRIVAL AND PARKING DEMAND — SITE A

Attendance	Bus Users (persons)	CalTrain Users (persons)	Car Users (persons)	Required No. of Parking Spaces
Evening and Weekend Events:				
17,500	350	275	16,875	5,620
20,000	400	310	19,290	6,430
Weekday Afternoon Event:				
11,000	550	--	10,450	2,610

Due to the family orientation of matinee shows usually large family groups attend these events and arrive together in automobiles or vans. The vehicle occupancy for automobiles used to travel to such functions is also reported to be higher than average. A vehicle occupancy of 4.0 persons per automobile is not uncommon. The use of public transit system is very low. However, the use of charter buses to carry school children and senior citizens is very extensive. The estimated number of parking spaces required for matinee events is based on an average attendance of 11,000 persons per event, an average vehicle occupancy of 4.0 persons per car with 5% arrivals by charter buses.

2.3 Parking Supply

The parking demand for an arena can be satisfied in a number of different ways depending on the day and the time the events are held. Some of the methods to satisfy the arena parking demand include the following:

1) Provide parking on the site.
2) Use the existing surrounding parking supply that is (a) within an acceptable walking distance and (b) having non-concurrent parking demand.

[1] Coliseum Consultants Letter of June 10, 1987

3) Provide a remote parking area with a shuttle bus operation to the arena.

To satisfy the parking demand for Site A, the first two strategies were adopted. Due to the size of the available parcels, not all parking could be accommodated on site. It would be necessary to utilize existing parking facilities that are available during the evenings and on the weekends and that are within an acceptable walking distance.

Research has shown that most parkers will accept walking distances ranging up to 1,500 feet between the parking facility and the nearest entrance to their destinations, and some parkers will accept walks of 2,000 feet or more. A relationship between walking distance and the use of parking facilities by the arena patrons was developed based on previous experience at similar arena sites in other cities. A graph showing the relationship between walking distance and the percentage use of a parking facility is shown in Figure 3. This relationship was verified by the results of a study conducted for the acceptance of walking distance to rapid transit stations.[2]

Recent studies have indicated that there is an upper limit to the tolerance of walking distances under North American conditions. Although, the trip purpose has some bearing on the length of the walking distance between the parking area and the final destination. For example, people going to arena for recreational purposes are willing to accept longer than usual distances (over 3,000 feet) as compared to shopping trips which require carrying of shopping bags, etc. In short, the tolerance of arena patrons has been observed to be high for accepting longer than usual walking distances.

Available Parking for Weekdays, Evenings, and Weekends

Site A would provide 2,020 parking spaces for the exclusive use of arena patrons. The remainder of the parking supply would have to be met by utilizing the available parking facilities within an acceptable walking distance. The inventory of available off-street parking spaces outlined in the earlier part of this chapter showed that 8,464 spaces will be available. In order to determine the percentage utilization of the parking facilities, the walking distance between each parking facility and Site A was measured. The parking facility locations are shown in Figure 4. The walking-distance and percentage-use graph discussed above and shown in Figure 3 was used to estimate the number of spaces that are likely to be used by arena patrons. Table 5 shows that there are 10,182 available parking spaces and that 7,211 parking spaces could possibly be used based on acceptable walking distances.

It should be noted that this analysis assumes that arena events would be held on weekday evenings starting at 7:30 PM or on the weekends. These parking facilities are fully utilized on weekdays between 7 AM and 5 PM by the occupants of the building they were designed to serve. It will be necessary to obtain permission from the owners of the parking facilities for their use by arena patrons. Park Center Plaza II Garage which is heavily utilized during the evenings by the patrons of Center for Performing Arts (CPA) was excluded from this study as a source of parking supply to serve arena patrons. Similarly, the River Park Towers Garage which is in the vicinity of the CPA was assumed to provide 60% of its capacity for arena patrons.

[2] Reference: Travel Behavior Associated with Land Uses Adjacent to Rapid Transit Stations, by M.G.P. Stringham.

Barton-Aschman Associates, Inc.

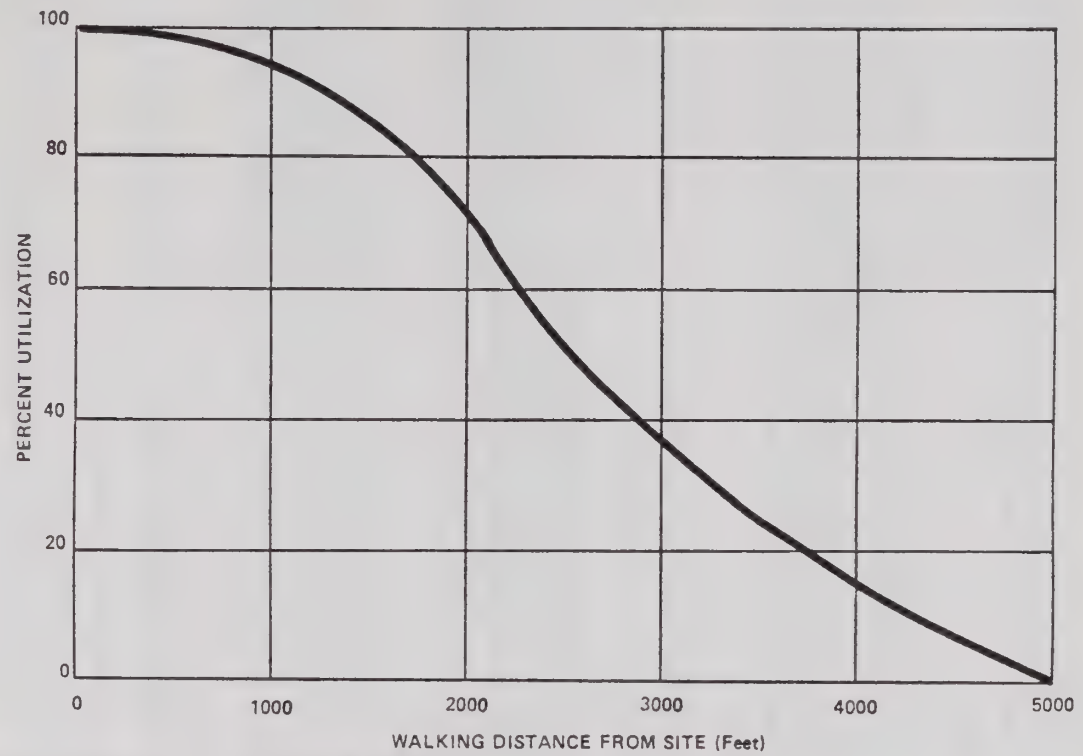


Figure-3

PARKING FACILITY UTILIZATION

Barton-Aschman Associates, Inc.

Figure-4

SITE "A" AVAILABLE PARKING FACILITIES

TABLE 5
PARKING SUPPLY AND ESTIMATED PARKING USAGE BY ARENA PATRONS — SITE A

Parking* Facility Number	Description	Total Spaces	Available For Arena Use	Spaces Available
1	On-Site	2,020	100%	2,020
2	Cahill Station	679**	100%	679
3	San Jose Water Company	372	100%	372
4	Parking Area Under Rt. 87	320	100%	320
5	Pacific Valley Bank Garage	700	75%	525
6	Park Center Plaza III	1,220	75%	915
7	Lincoln Property Garage	1,300	60%	780
8	Boone-Fox Bldg. (Not Built)	873	60%	525
9	William Wilson Bldg.	715	60%	430
10	Herron Bldg.	483	40%	195
11	Market Street Garage	1,500	30%	450
	TOTAL	10,182	70%	7,211

* For Location Refer to Figure 4.
** According to new site plan for Cahill Station.

Available Parking for Weekday Afternoons

The parking demand for weekday afternoon events was estimated to be 2,610 spaces 2,020 parking spaces will be available on-site for these events. The 320 spaces under Route 87 could be reserved for days when the afternoon events are scheduled. The remaining 270 parkers would be absorbed in the 10 available parking areas.

Employee Parking

The parking areas on-site will be reserved for customers. Therefore arena employees would not be allowed to park there. In order to satisfy the employee parking demand it would be necessary to establish a remote parking area for their use. The employees would be required to park at this location.

Arena On-Site Parking Alternatives

Two site development alternatives are proposed for Site A which are described below. Under each alternative, several parking options are being considered. The alternatives are described below:

Arena On-Site Parking Alternative A-1:

A two-phase parking plan is proposed under this alternative. Each phase will provide all the 2,020 parking spaces.

Phase 1

In this phase the 2,020 parking spaces will be located within three areas. A surface parking lot with 575 spaces will be located in the block surrounded by Autumn Street, Saint John Street, Los Gatos River/Guadalupe River and Santa Clara Street. A parking garage with 1,370 spaces is proposed west of Montgomery Street just north of the proposed arena building site. The remaining 75 spaces will be provided in a surface lot west of Autumn Street and south of Saint John Street.

Phase 2

In this phase the 2,020 on-site parking spaces will be located differently than in Phase 1. The 575 spaces on the surface lot will be eliminated to provide room for the Guadalupe River Park. There are two options to replace this parking. Option 1 proposes that these spaces be provided on another surface lot located at the south-west quadrant of Julian Street and Montgomery Street. Under Option 2 these spaces will be provided in a garage in the block bound by Santa Clara Street, Montgomery Street, Crandall Street and Cahill Street.

Arena On-Site Parking Alternative A-2:

A two-phase parking plan is proposed under this alternative. Each phase will provide all of the 2,020 parking spaces.

Phase 1

In this phase the 2,020 on-site parking spaces will be located in four facilities. A surface parking lot with 575 spaces will be located in the block surrounded by Autumn Street, Saint John Street Los Gatos River/Guadalupe River and Santa Clara Street. Another surface lot with 535 parking spaces will be situated west of Montgomery just north of the proposed arena building site. A parking garage is proposed with 835 spaces in the block bounded by Santa Clara Street, Montgomery Street, Crandall Street and Cahill Street. The remaining 75 spaces will be provided in a surface lot west of North Autumn Street and south of Saint John Street.

Phase 2

In this phase the 2,020 on-site parking spaces will be located differently, then in Phase 1. The 575 spaces on the surface lot will be eliminated to provide room for Guadalupe River Park. These lost spaces will be provided in a parking structure at the site of the surface lot west of Autumn Street and north of the proposed arena building.

Conclusions

According to the available parking supply analysis there would be 7,211 parking spaces available for arena patrons for evening and weekend performances. The parking demand analysis showed that there would be a need for 5,620 spaces for a 17,500 seat arena and 6,430 spaces for a 20,000 seat facility. Therefore, there would be an excess of about 1,600 available parking spaces for arena patrons for the 17,500 seat arena and 780 spaces for the 20,000 seat arena in the general area. This surplus would ensure sufficient parking supply for arena patrons for evening and weekend events without relying on the neighborhood street parking spaces.

The weekday afternoon shows would require an estimated 2,610 spaces. All but 270 spaces could be reserved for these events. The several private parking garages could satisfy the remaining demand of 270 spaces.

2.4 Proposed Parking Strategies

The parking demand and supply analysis outlined in this chapter led to the following parking strategy.

- Site A would provide 2,020 parking spaces on site. These spaces should be reserved for arena patrons only.
- A comprehensive long term plan should be prepared to provide parking for arena employees at a location away from the site. This arrangement should be strictly enforced.
- Arrangements should be made to provide parking areas for truck-trailers and rigs used for arena events, away from the site during the arena performance. This arrangement should be strictly enforced.
- Arrangements should be made to provide on-site parking for charter buses used by arena patrons.
- In order to ensure the availability of privately owned parking facilities for arena patrons, arrangements should be made with the owners of these facilities.
- The parking demand for afternoon matinee events should be monitored closely. If the demand exceeds the supply, arrangements should be made to increase the parking at or near the arena.

3. TRAFFIC IMPACT ANALYSIS

The objective of this analysis is to determine how the transportation system will be affected by the arena project. For a complete traffic analysis of the site under consideration, five different time scenarios were considered for each of two different seating capacities. The five scenarios are:

1. Weekday PM Peak Hour Analysis (between 4:00 and 6:00 PM) with an arena event starting time of 6:00 PM.
2. Weekday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.
3. Weekday Late Evening Peak Hour Analysis (between 10:00 PM and 12:00 Midnight) with an arena event ending time of 10:30 PM.
4. Friday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.
5. Saturday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.

The two different seating capacities considered are 17,500 seats and 20,000 seats.

For matinee events between 1:30 and 4:00 PM, a traffic analysis was not conducted because the attendance at these events is projected to be only 11,000 persons, which is not as critical as the 17,500 or 20,000 persons attendance level for the weekday PM peak hour.

The different scenarios were evaluated for existing, Year 1991, and Year 2000 traffic conditions.

3.1 Existing Conditions

The City of San Jose selected twenty critical intersections around the proposed Site A for traffic impact analysis. These locations are shown in Figure 5. Descriptions of the tasks performed and analyses conducted for evaluating existing conditions are provided in the following sections.

Data Collection

Data collected for similar arena facilities in other areas indicated that about 93% of the arena patrons arrive during the hour before the start of the event. For events starting at 7:30 PM, approximately 4% would arrive during the PM peak hour between 5 PM and 6 PM and the remaining 3% would arrive at other times.

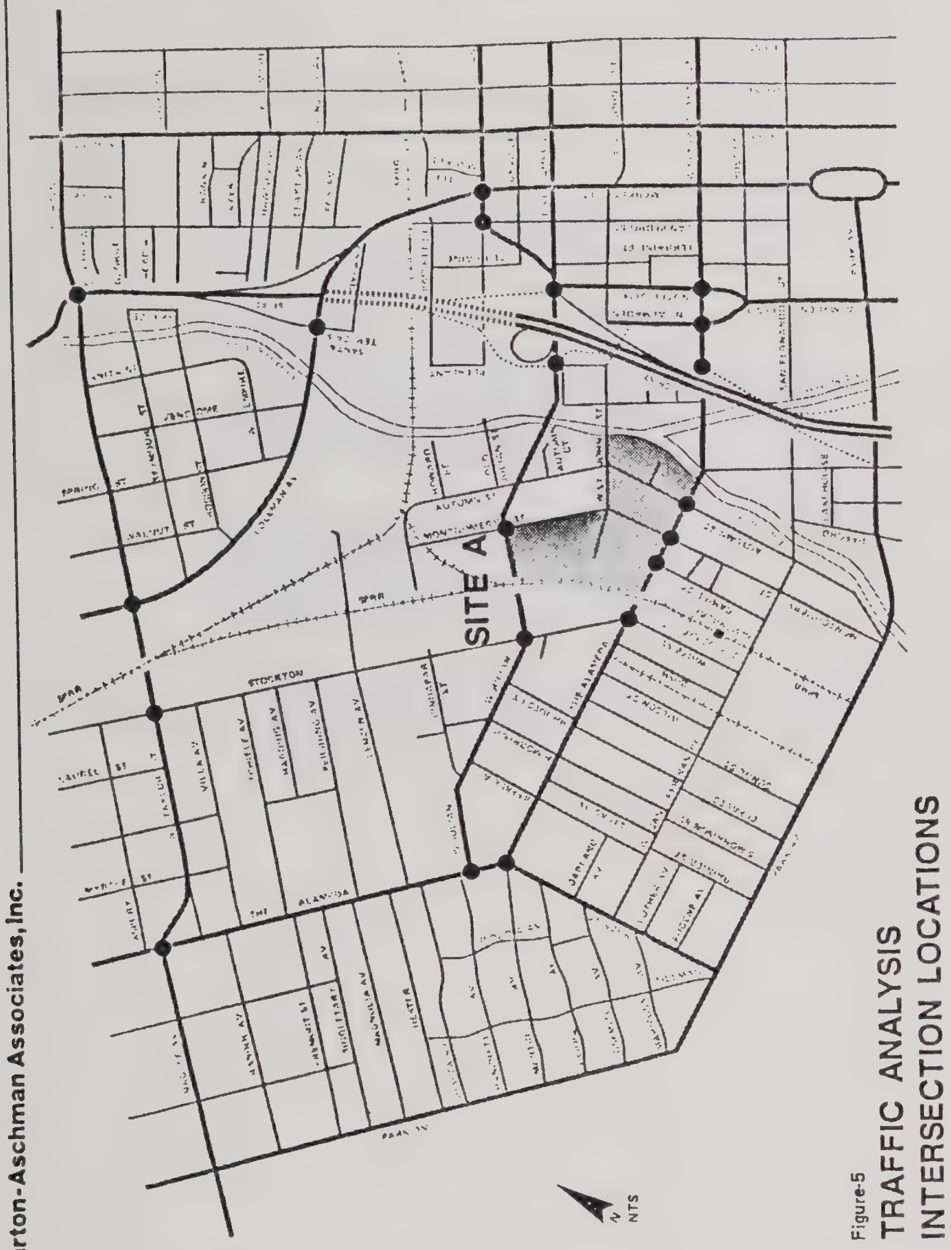


Figure-5
TRAFFIC ANALYSIS
INTERSECTION LOCATIONS

Barton-Aschman Associates, Inc.

The departure pattern varies more so by type of event. For example, it has been noted that for basketball events, an estimated 48% of the patrons leave before the end of the event, while for entertainment events, only 7% were found to have departed the surveyed site prior to the conclusion of the event.

Approximately two or three times a year, arena events may begin as early as 6:00 PM. These are events which would be broadcasted to audiences nationwide.[3] For these events the peak hour of arena patron arrival would occur during the PM peak period. However, the starting time for most arena events is expected to be 7:30 PM with the peak hour for arena patron arrival occurring between 6:30 and 7:30 PM. An event with an ending time around 10:30 PM would result in a peak hour for arena patron departure of around 10:30 to 11:30 PM.

The traffic counts for the PM peak hour were obtained from the City of San Jose. For intersection locations where counts were taken during the previous years, an annual growth factor of 3.6 percent was applied to reflect existing (1987) traffic conditions. The peak hour counts for the remaining time periods were obtained from recent manual turning movement counts conducted by Barton-Aschman Associates, Inc. Traffic counts were taken during the evening period between 6:30 and 8:30 PM and the late evening period between 10:00 PM and Midnight. The traffic counts conducted on Friday evenings between 6:30 and 8:30 PM reflected the increased activity level of the general area. The Center of Performing Arts, Montgomery Threatre, and Civic Auditorium are all located in the vicinity of the proposed site. On the Friday evenings when the counts were conducted, these facilities held events that attracted peak season crowds.

Intersection Operation

The traffic conditions at an intersection can be described in the terms of Level of Service (LOS). Level of Service is a qualitative description of an intersection's operation based on the amount of traffic, conflicting traffic movements, delays and congestion. Levels of Service can range from A, representing free flow conditions, to F, representing jammed conditions. Generally, the Level of Service is derived from the ratio of traffic volumes and available capacity shown as V/C ratios. The various levels of service, their descriptions and range of V/C ratios are shown in Table 6.

A signalized intersection's level of service can be calculated with a number of different methods. The City of San Jose has adopted its own method which is based on critical traffic movements. In this method the volume of cars completing the turning movements that dictate the operation of the intersection are added together. The sum is divided by the capacity of the movements, and a volume to capacity ratio is obtained. The volume-to-capacity ratio is correlated to a level of service described in Table 6.

An intersection operating under stop control can be evaluated using the methodology described in the Highway Capacity Manual, Special Report 209; published by the Transportation Research Board. Unlike the level of service

---

3 Telephone conversation with Mr. Bill Cunningham, July 16, 1987.

TABLE 6
INTERSECTION LEVEL OF SERVICE DEFINITIONS

Level of Service	Interpretation	V/C Ratio
A, B	Uncongested operations; all queues clear in a single signal cycle.	Less Than .7
C	Light congestion; occasional backups on critical approaches.	.700 - .799
D	Significant congestion on critical approaches but intersection functional. Cars required to wait through more than one cycle during short peaks. No long-standing queues formed.	.800 - .899
E	Severe congestion with some long-standing queues on critical approaches. Blockage of intersection may occur if traffic signal does not provide for protected turning movements. Traffic queue may block nearby intersection(s) upstream of critical approach(es).	.900 - .999
F	Total breakdown, stop-and-go operation.	1.0 And Greater

definitions given in Table 6 for signalized intersections, the level of service criteria for this methodology are stated in very general terms, and are related to general delay and reserve capacity ranges.

Existing Intersection Level of Service:

The results of the level of service calculations performed for the twenty intersections for the different time periods are presented in Table 7. In general, the City of San Jose considers any intersection operating below Level of Service D, as unacceptable. The results of the intersection level of service analyses indicated the following number of intersections with unacceptable operations associated with each of the scenarios.

— Weekday PM peak hour: 5 intersections

— Weekday Evening peak hour: None

— Weekday Late Evening peak hour: None

— Friday Evening peak hour: 1 intersection

— Saturday Evening peak hour: None

Hourly Traffic Variation

Traffic volumes on the street system vary over the twenty-four hour period and over the seven days of the week. During the weekday AM and PM peak periods there are more vehicles on the roadways than during the mid-day period. At night, traffic volumes on most streets are relatively low. On the weekends, the average daily traffic (ADT) is lower than for a typical weekday.

Different types of roadway facilities have different hourly variations throughout the day. For example, major arterials carrying heavy commuter traffic have a different pattern from streets serving retail areas.

In order to determine the travel pattern for the area in the vicinity of Site A, 24-hour counts were conducted at the following locations (see Figure 6):

1. Almaden Boulevard south of Santa Clara.
2. Santa Clara Street east of Autumn.
3. The Alameda south of Shasta
4. Julian Street east of Southern Pacific overpass.
5. Shasta Avenue west of The Alameda (Friday and Saturday Count).
6. Hanchett Avenue west of The Alameda (Friday and Saturday Count).

The machine counts were taken in May 1987. The highest weekday and Saturday daily traffic volumes are given in Table 8. The hourly totals for these counts were plotted in graphical form to determine the hourly travel pattern, the traffic volumes during peak travel times, and the off-peak travel characteristics. The hourly variations for the six locations are shown in Figures 7 through 23.

TABLE 7
EXISTING INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM		WKDY EVE.		WKDY LATE EVE.		FRI. EVE.		SAT. EVE.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C
Alameda & Taylor/Naglee	E	.928	A	.293	A	.136	A	.563	N.A.	
Stockton & Taylor	A	.462	A	.116	A	.047	A	.222	N.A.	
Coleman & Taylor	D	.821	A	.137	A	.079	A	.279	N.A.	
SR 87 & Taylor	C	.767	A	.337	A	.126	A	.474	N.A.	
SR 87 Off-Ramp (SB) & Coleman	F	1.072	A	.457	A	.176	A	.550	N.A.	
San Pedro & Julian	E/d/		C		A		E		A	
Market & Julian	E	.960	A	.325	A	.194	A	.436	A	.299
Alameda & Julian/Hanchett	B	.688	A	.210	A	.111	A	.362	A	.220
Stockton & Julian	D	.813	A	.225	A	.138	A	.369	A	.153
Montgomery & Julian	A	.501	A	.122	A	.047	A	.243		
SR 87 On-Ramp (SB) & Julian	N.A./c/		N.A.		N.A.		N.A.		N.A.	
SR 87 On-Ramp (NB)/Notre Dame & Julian	D	.811	A	.372	A	.084	A	.274	A	.138
Alameda/Race & Martin	C	.718	A	.242	A	.126	A	.360	A	.201
Stockton & Alameda	F/d/		A		A		A		A	
Cahill & Alameda	B	.645	A	.235	A	.115	A	.305	N.A.	
Montgomery & Alameda	A	.564	A	.186	A	.079	A	.279	A	.160
Autumn & Santa Clara	A	.353	A	.131	A	.080	A	.202	A	.112
SR 87 Off-Ramp (NB) & Santa Clara	N.A.		N.A.		N.A.		N.A.		N.A.	
Santa Teresa (N. Almaden) & Santa Clara	D	.845	A	.329	A	.171	A	.408	A	.230
Notre Dame & Santa Clara	B	.632	A	.246	A	.141	A	.400	A	.230

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections

Barton-Aschman Associates, Inc.

Figure-6
MACHINE COUNT LOCATIONS

TABLE 8
SUMMARY OF 24-HOUR MACHINE COUNTS

Count Location			24-Hour Traffic Volumes Highest Weekday/a/	Saturday
1.	Almaden Boulevard south of Santa Clara	NB/b/	12,055	5,899
		SB/c/	9,966	4,460
		Total	22,021	10,359
2.	Santa Clara Street east of Autumn	EB	11,570	6,948
		WB	9,854	6,348
		Total	21,424	13,296
3.	The Alameda south of Shasta	NB	16,082	9,133
		SB	14,412	8,625
		Total	30,494	17,758
4.	Julian Street east of Southern Pacific overpass	EB/d/	5,663	2,297
		WB/e/	6,683	2,863
		Total	12,346	5,160
5.	Shasta Avenue west of The Alameda	EB	—	—
		WB	—	—
		Total	694	499
6.	Hanchett Avenue west of The Alameda	EB	—	—
		WB	—	—
		Total	2,556	1,241
7.	Stockton Avenue south of Lenzen/g/	NB	6,755	N.A./f/
		SB	6,718	
		Total	13,473	

/a/ At all count locations, highest weekday volumes occurred on Fridays
/b/ NB = Northbound
/c/ SB = Southbound
/d/ EB = Eastbound
/e/ WB = Westbound
/f/ N.A. = Not Available
/g/ Earlier count taken on January 29, 1987.

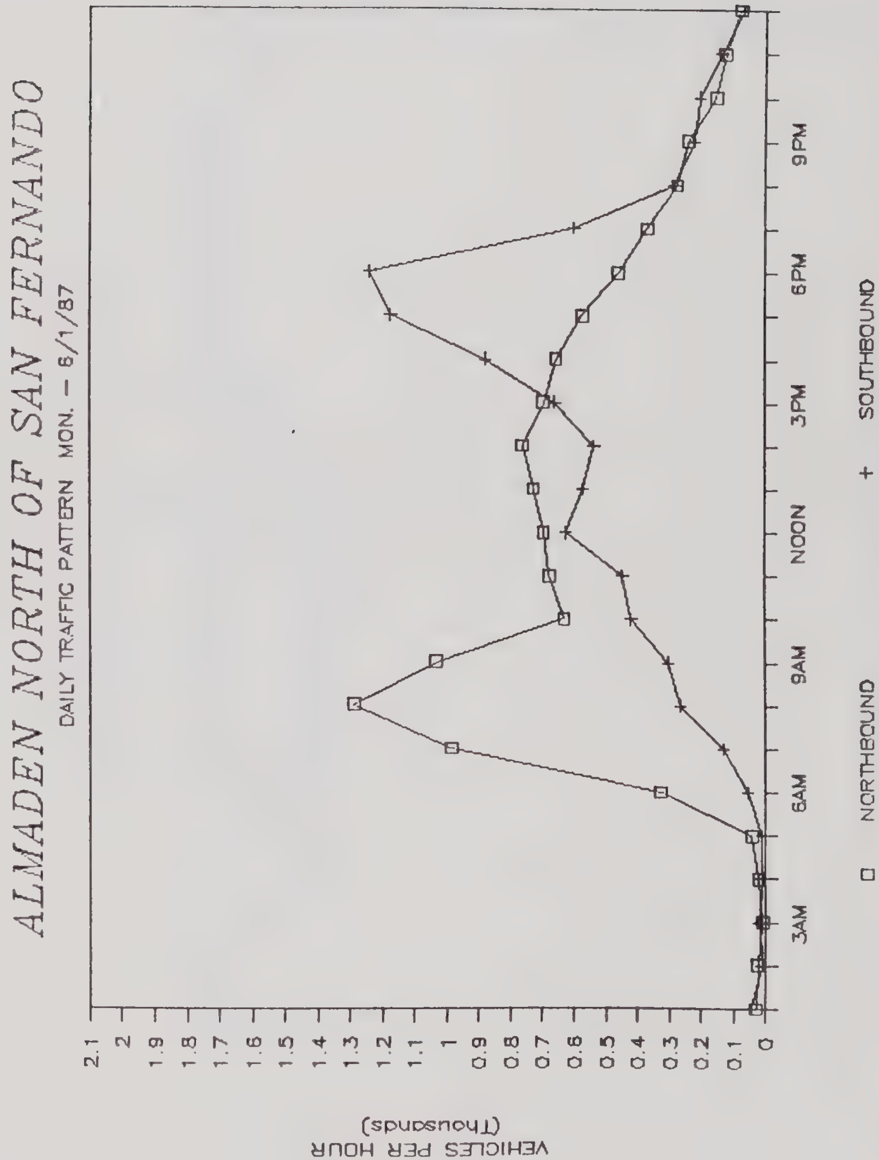


Figure-7

ALMADEN NORTH OF SAN FERNANDO

DAILY TRAFFIC PATTERN SUN. – 5/31/87

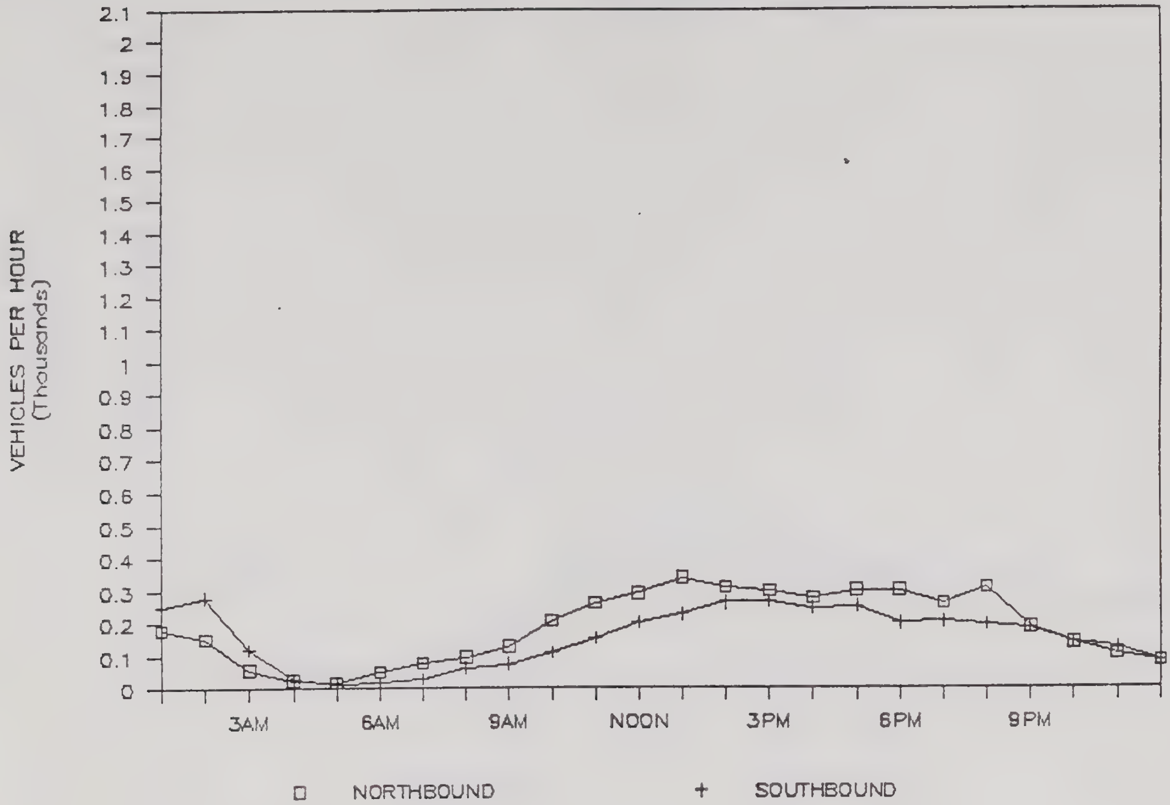


Figure-9

ALMADEN NORTH OF SAN FERNANDO

DAILY TRAFFIC PATTERN SAT. – 5/30/87

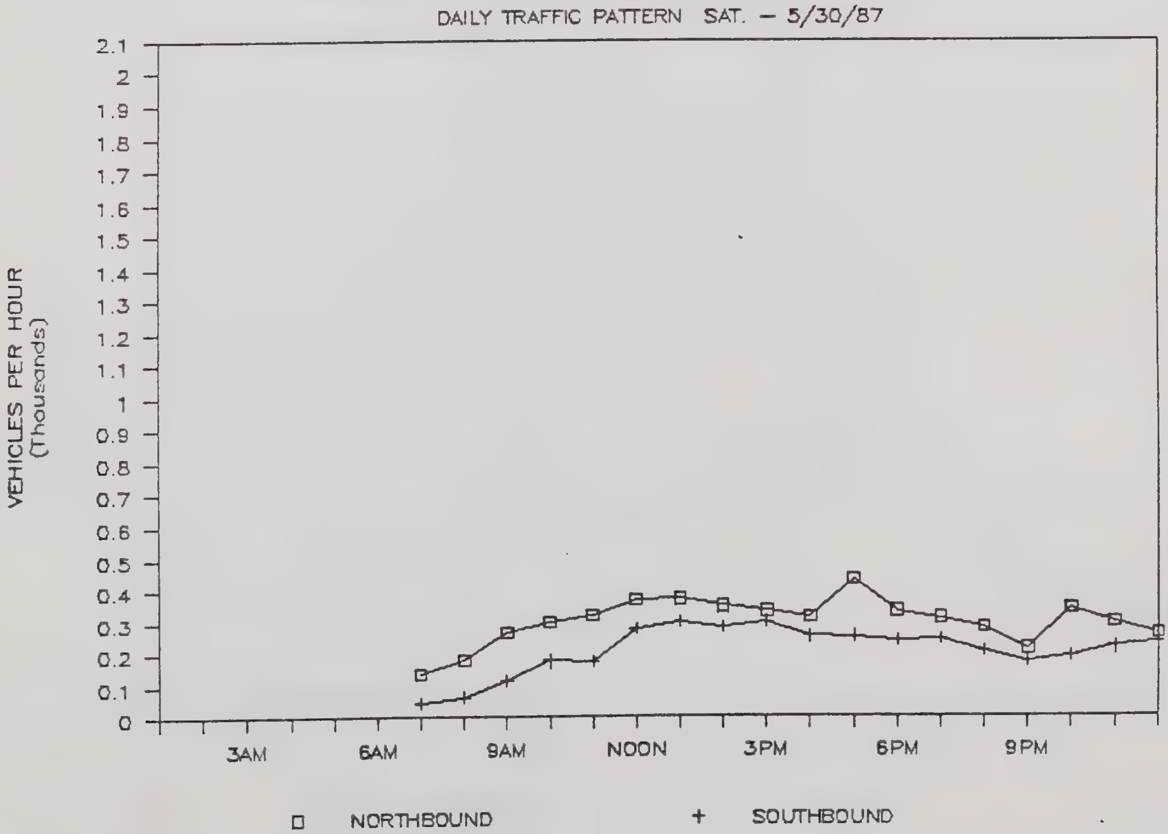


Figure-8

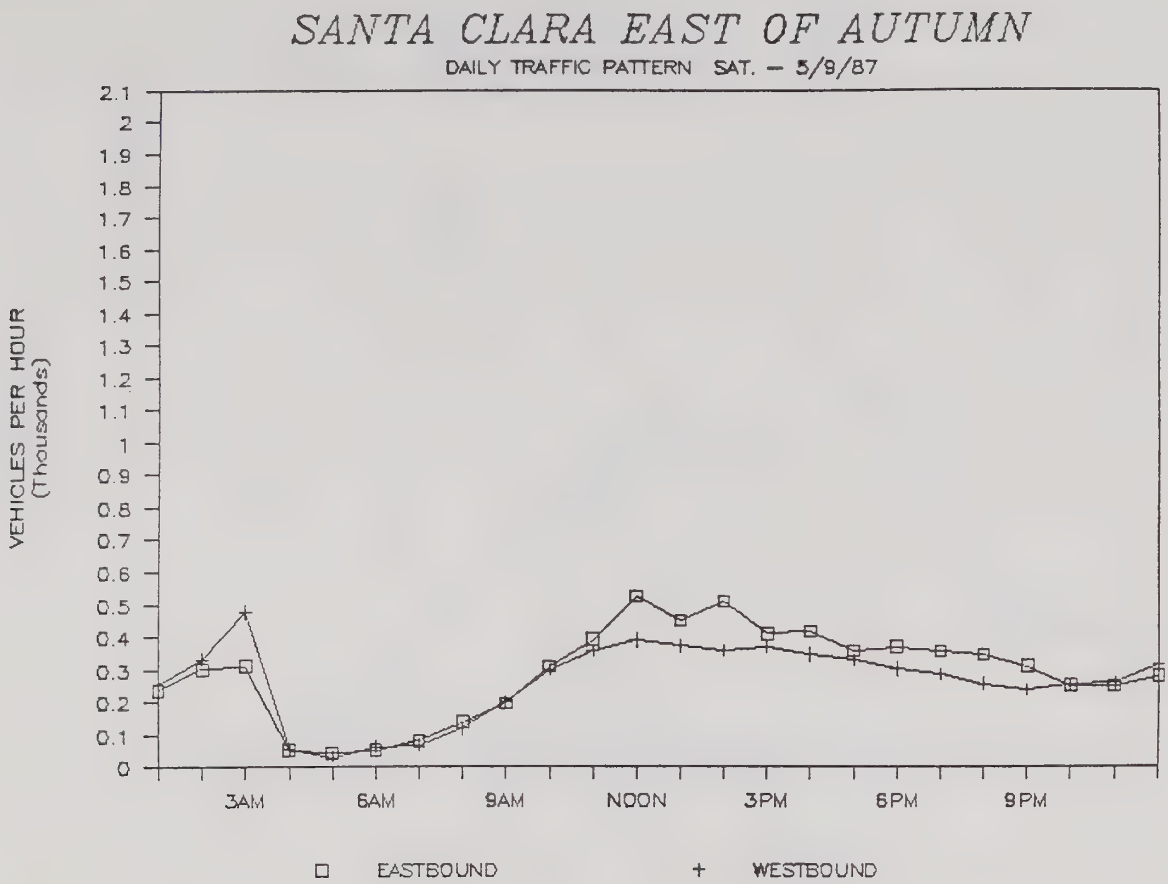


Figure-11

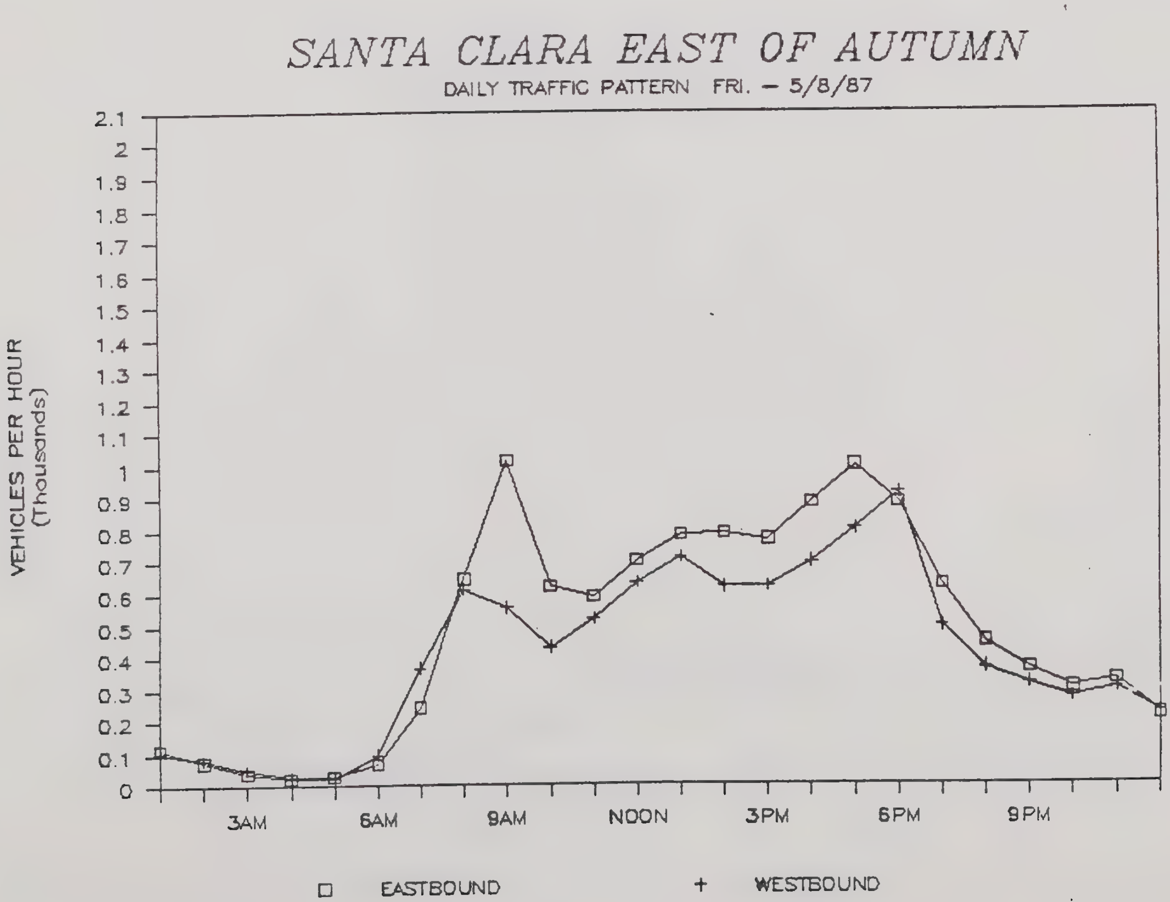


Figure-10

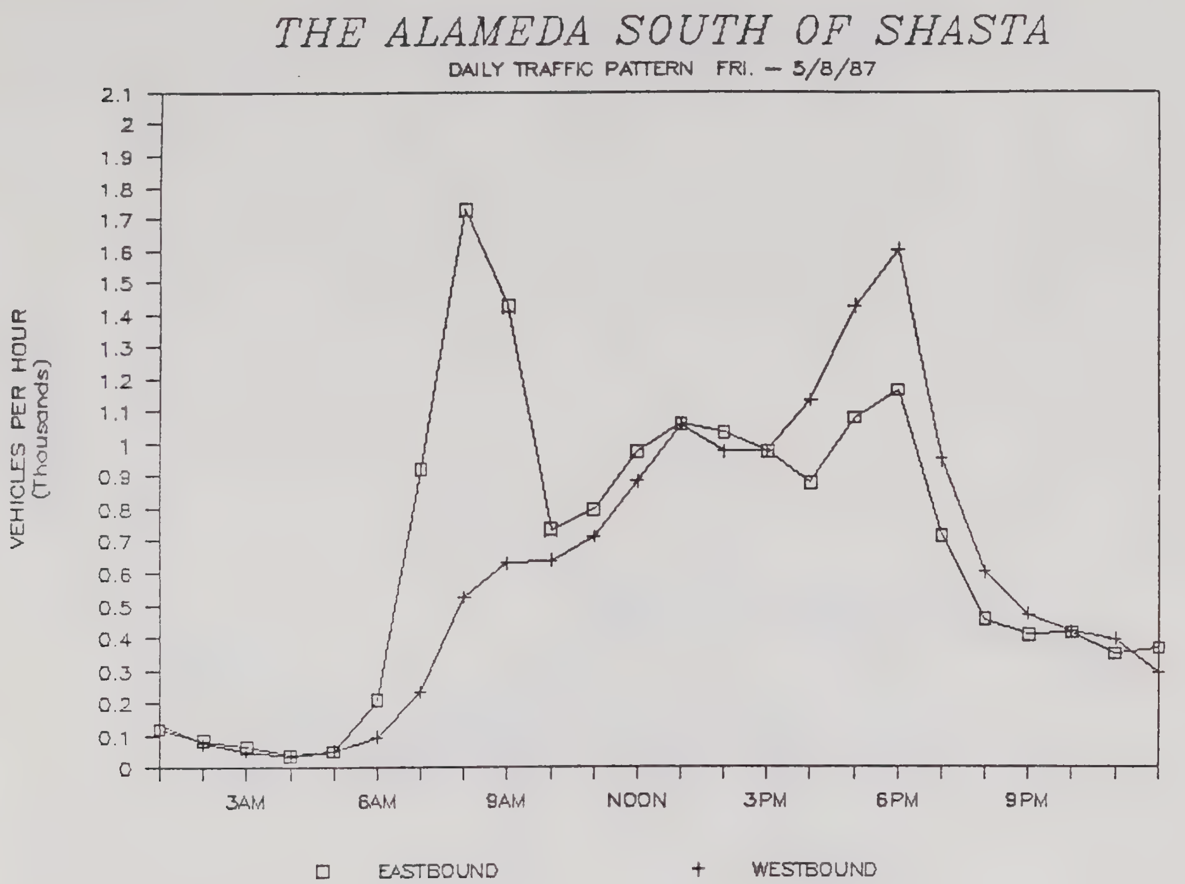


Figure-13

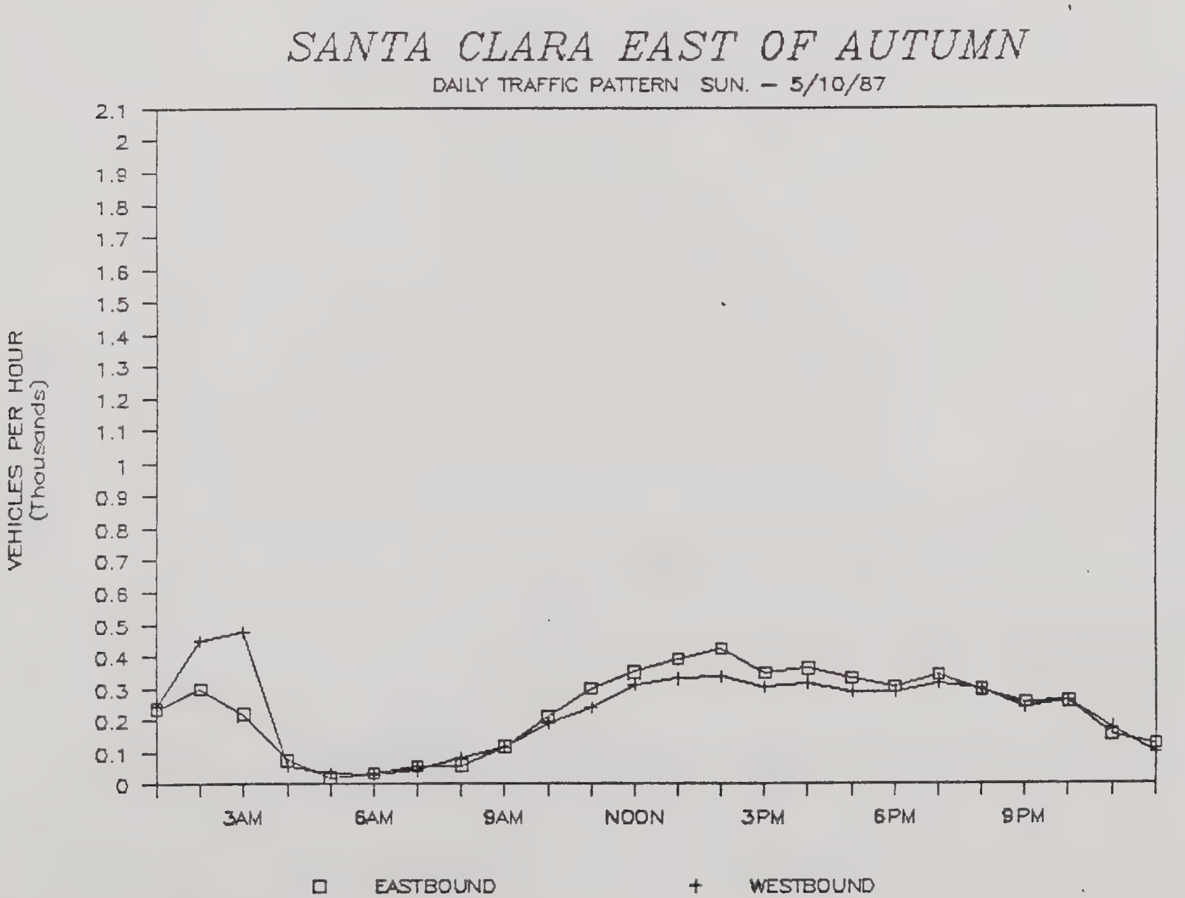


Figure-12

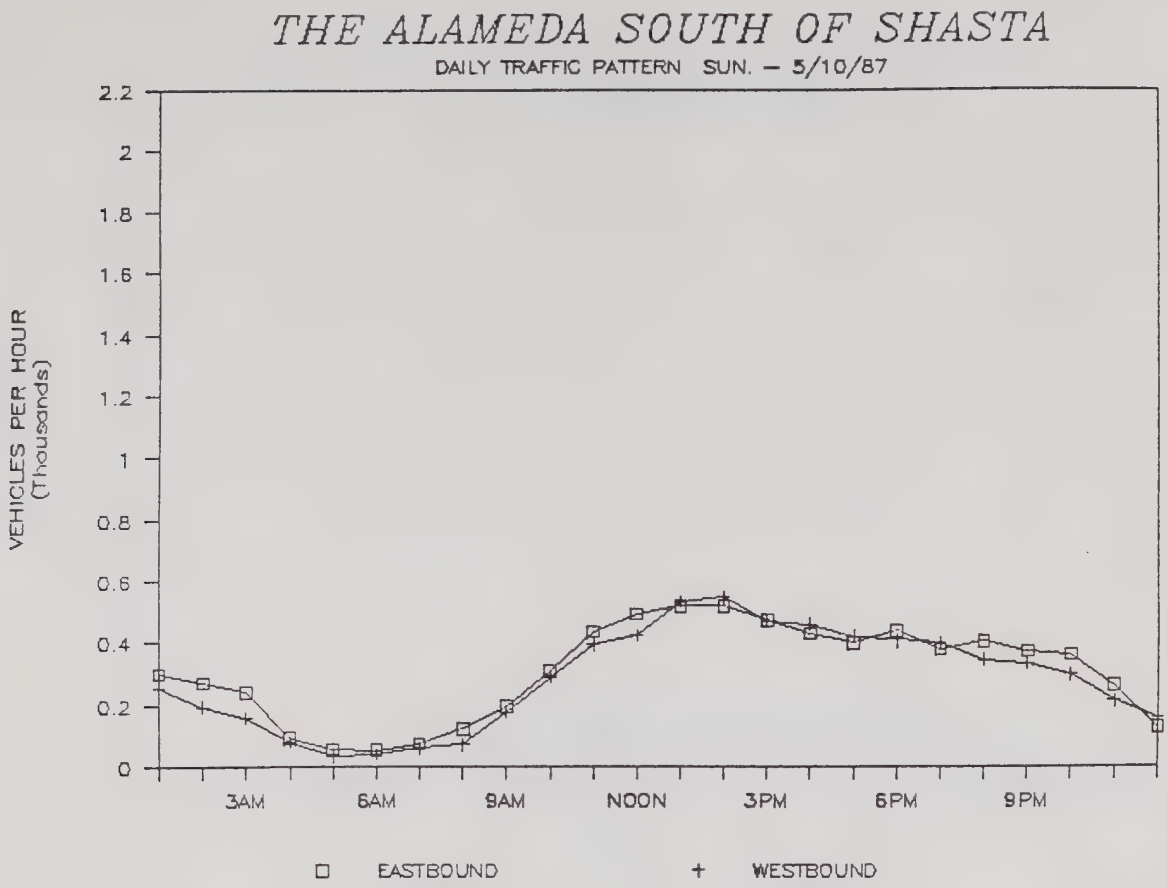


Figure-15

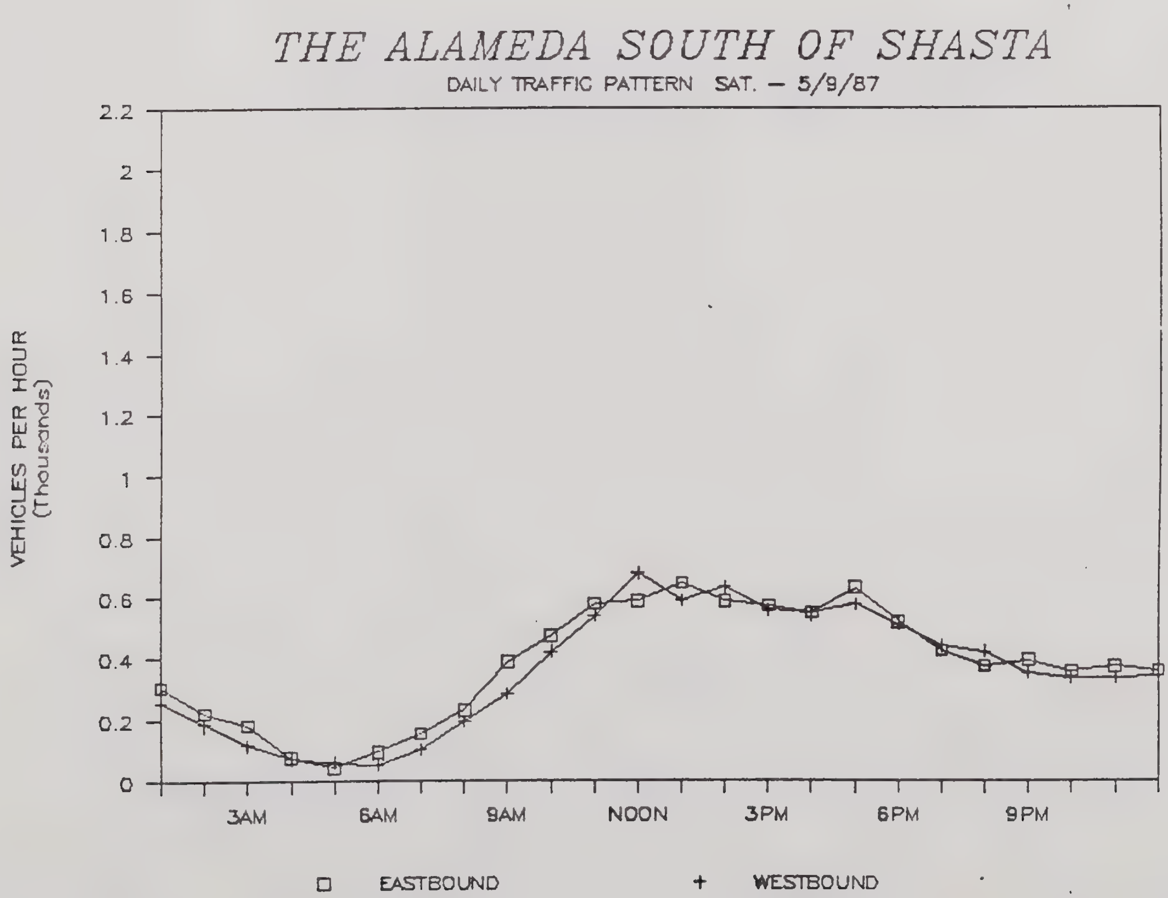


Figure-14

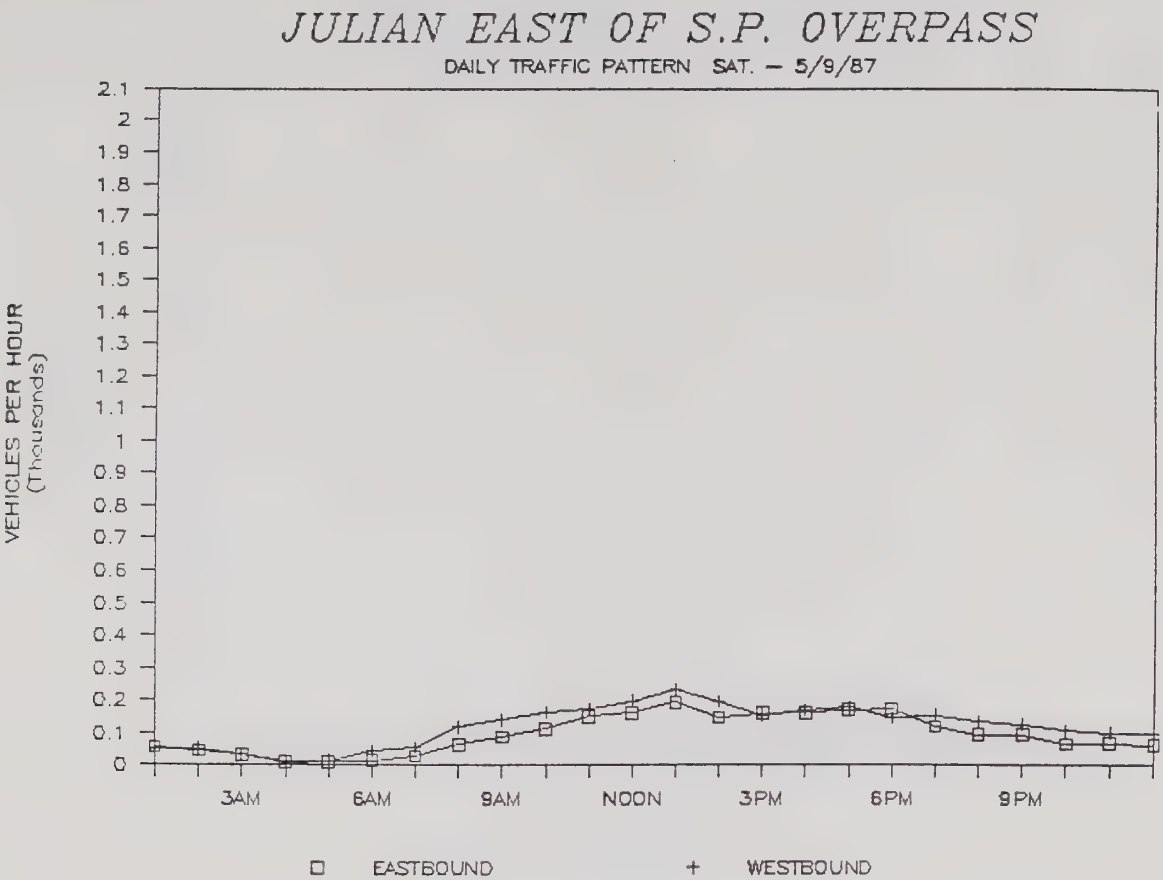


Figure-17

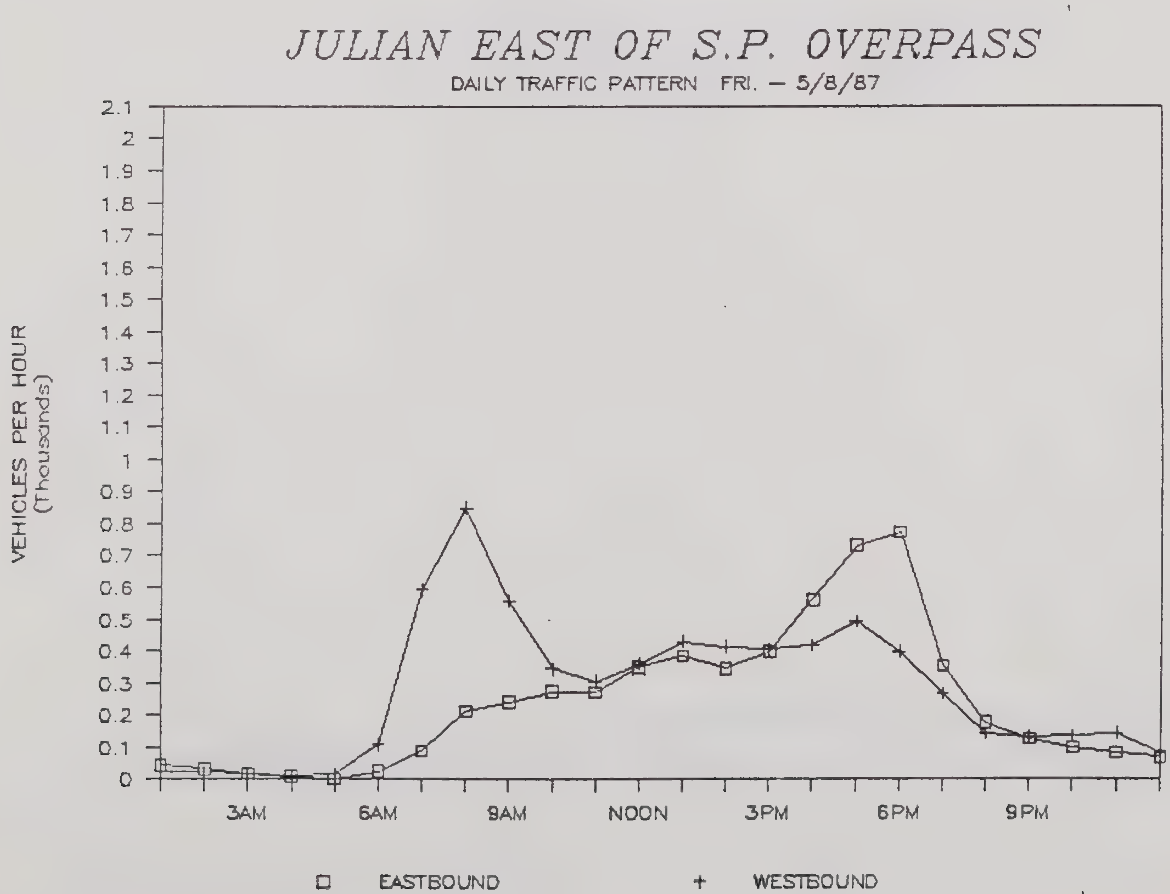


Figure-16

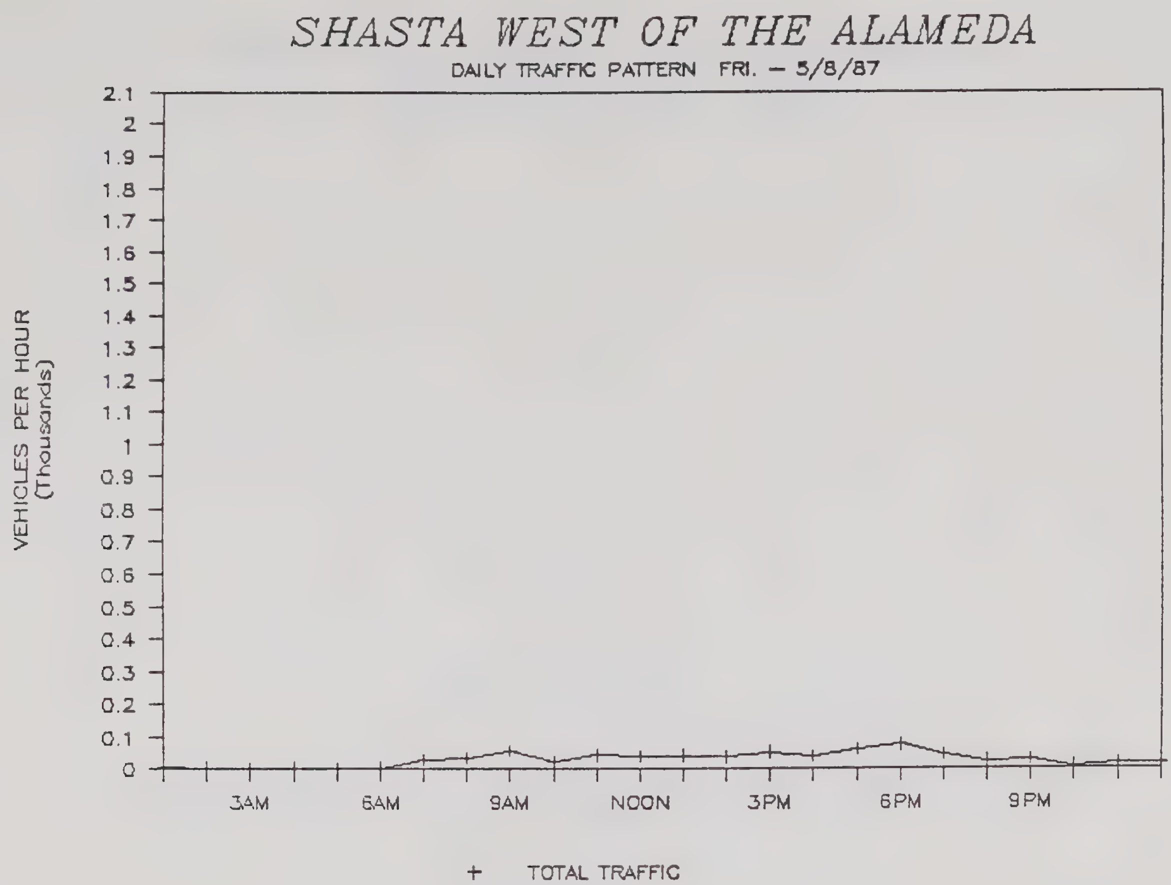


Figure-19

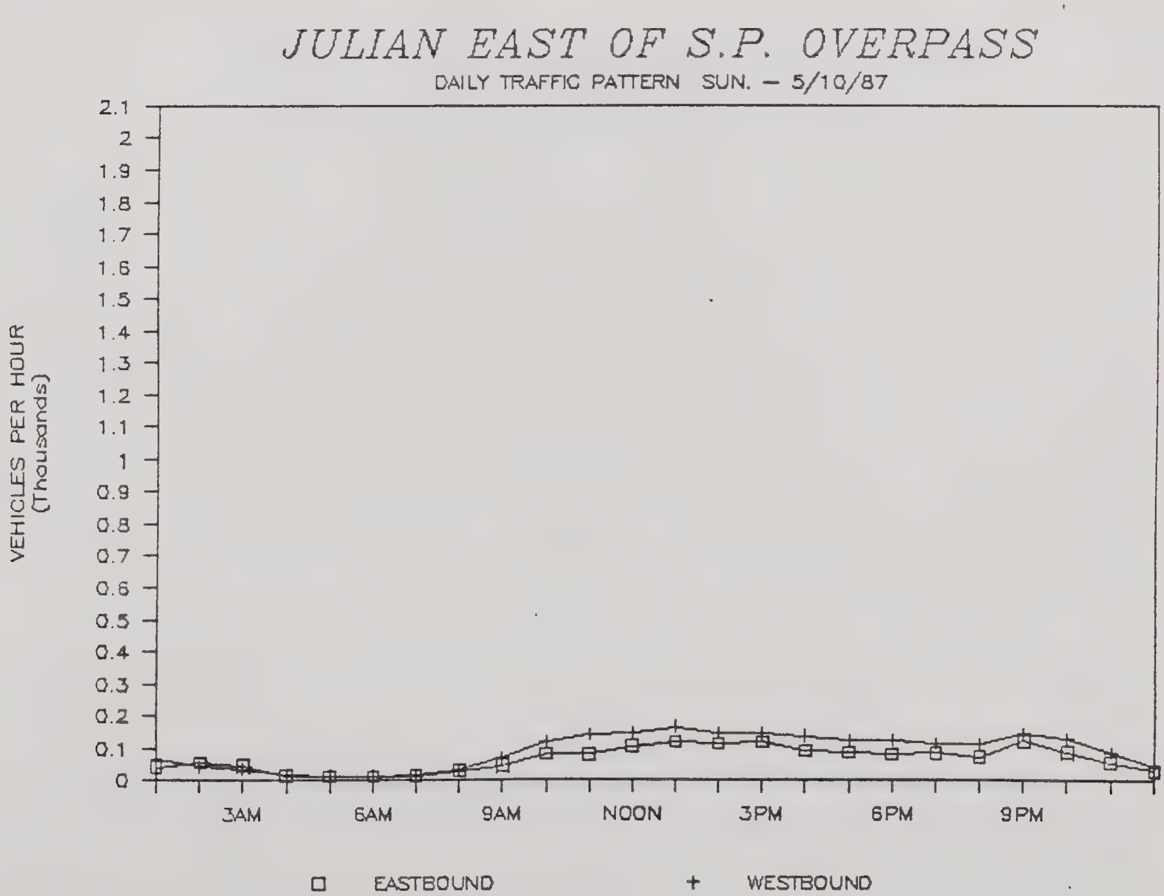


Figure-18

HANCHETT WEST OF THE ALAMEDA

DAILY TRAFFIC PATTERN FRI. – 5/8/87

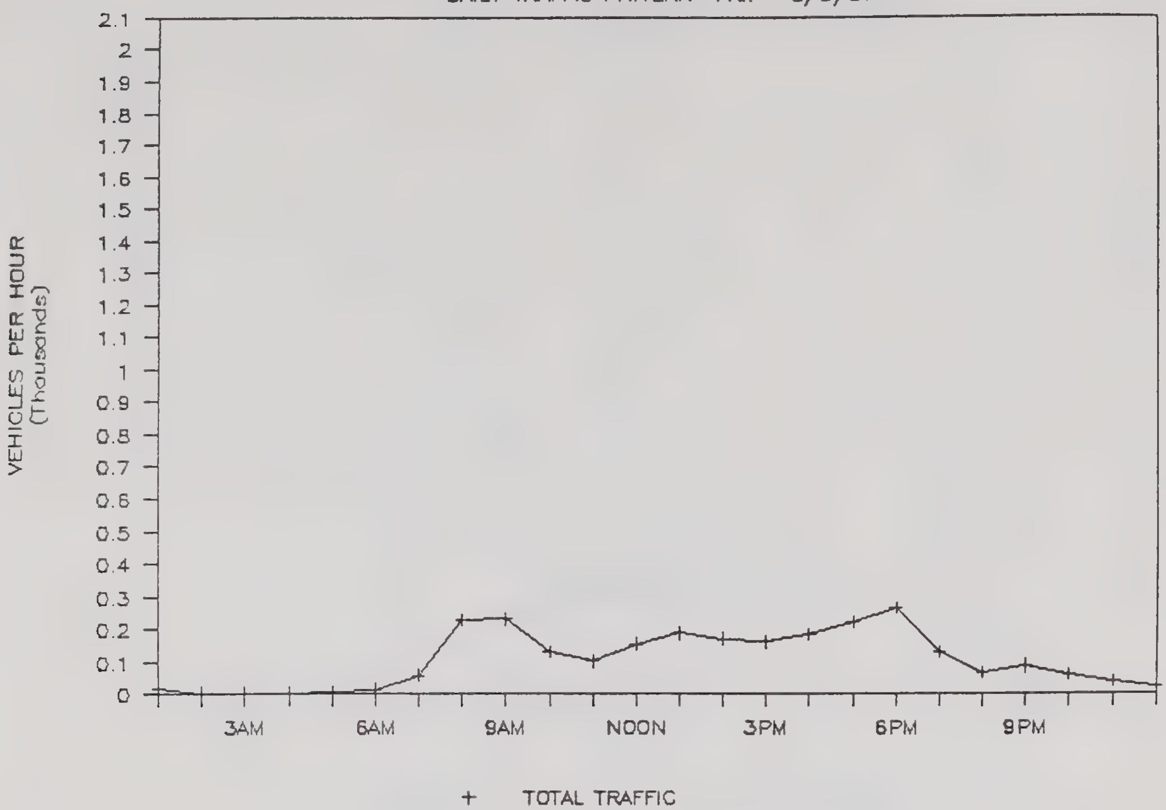


Figure-21

SHASTA WEST OF THE ALAMEDA

DAILY TRAFFIC PATTERN SAT. – 5/9/87

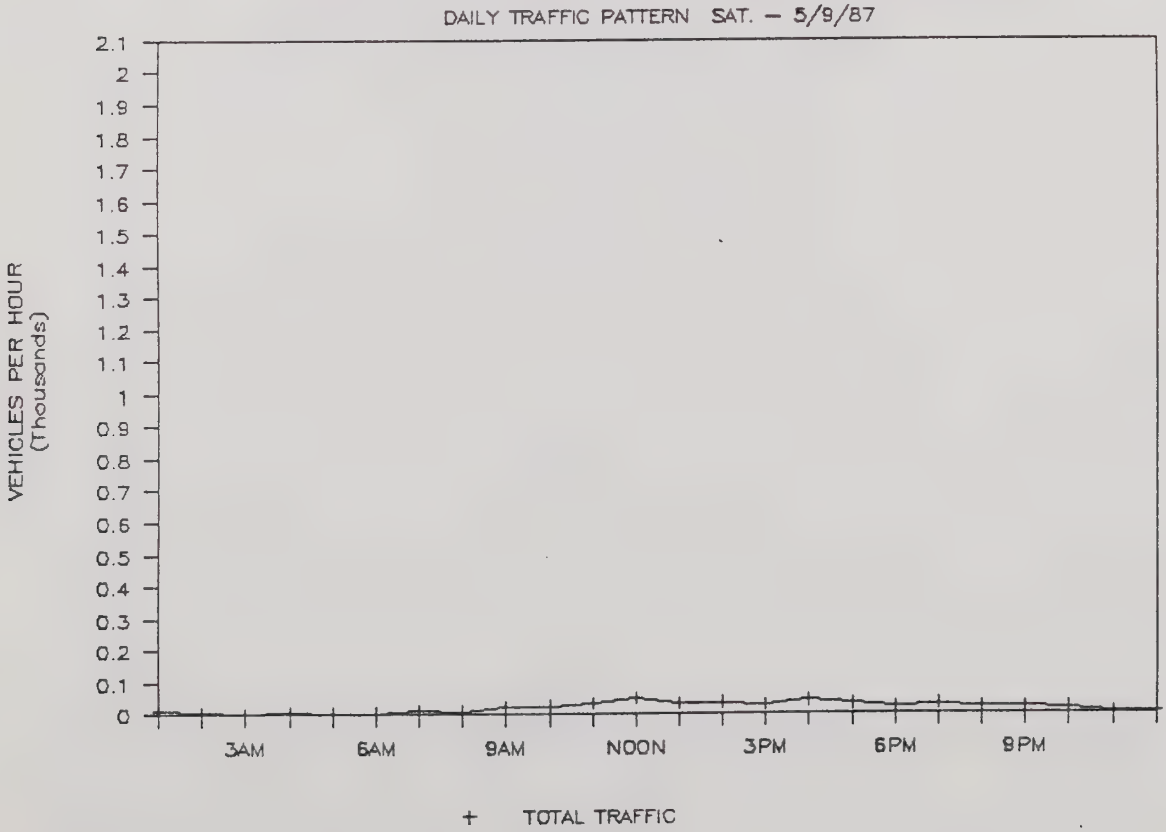


Figure-20

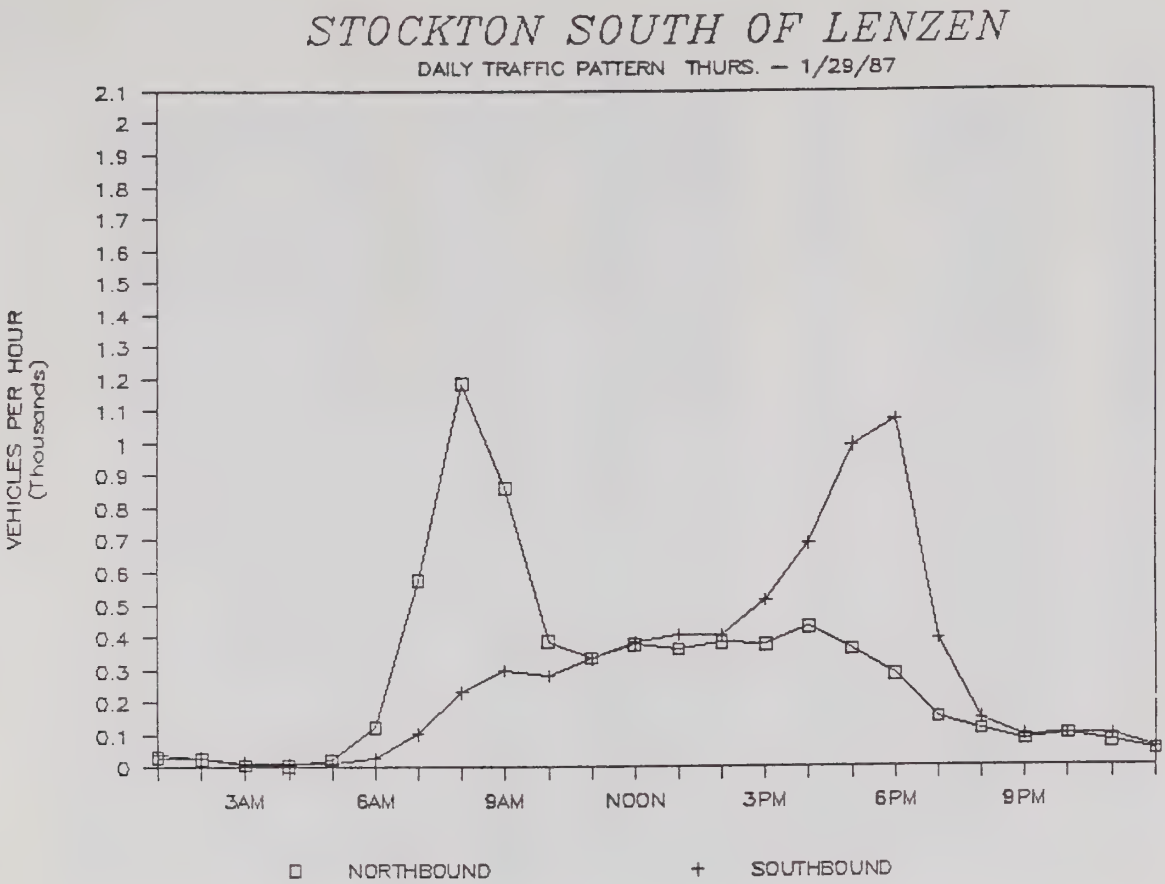


Figure-23

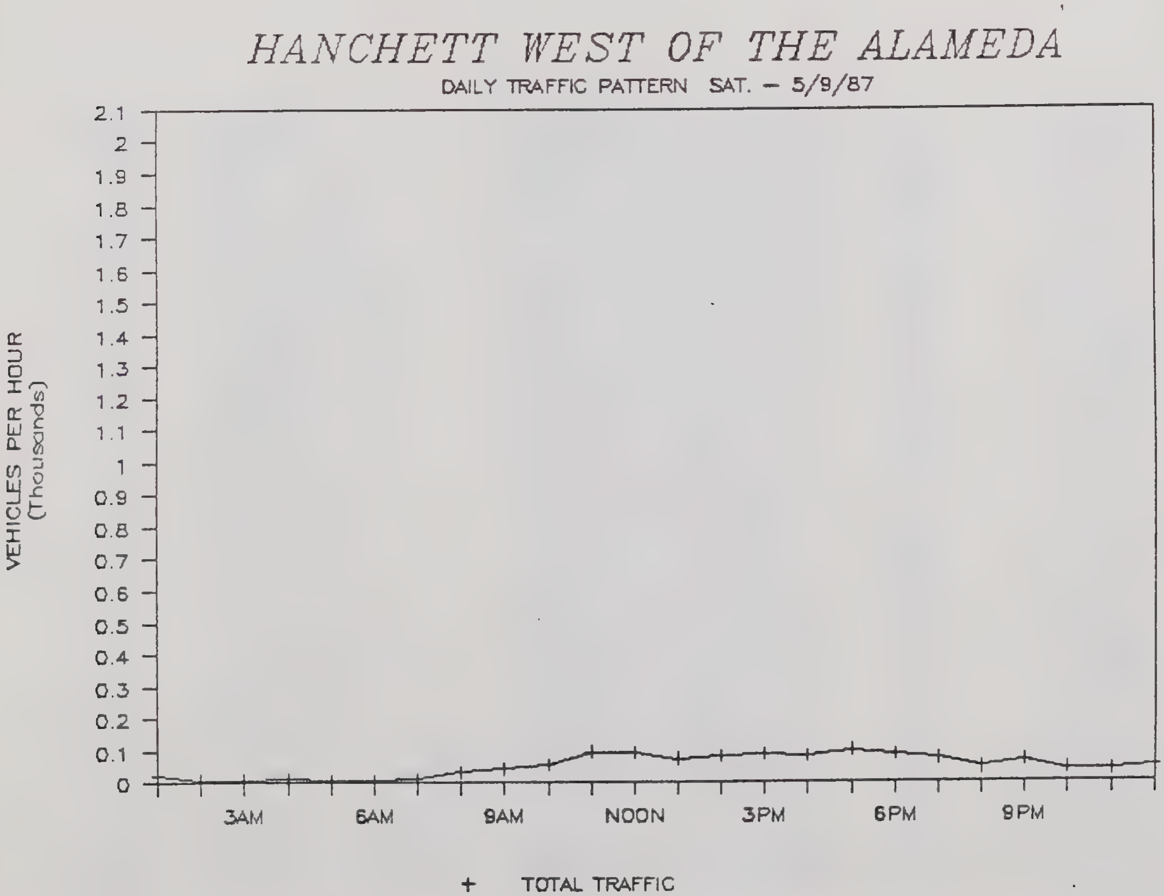


Figure-22

The count data show that for all locations measured the weekday with the highest traffic volumes is Friday. Also, the amount of traffic on the roadways is higher on Fridays than on Saturdays. During the weekdays the AM peak hour traffic volumes are comparable to the PM peak hour volumes. Generally, the traffic volumes drop sharply after 6:00 PM.

It should be noted that these graphs clearly reflect the character of the street and the function that it performs. For example arterial streets carry a significant amount of commuter travel on weekdays during the AM and PM peak periods. These commute patterns are reflected in the high peaks on the graph. The same street on Saturday and Sunday have a low steady traffic flow all day without any peaks.

Similarly, due to the local character of residential streets, they generally carry low volumes and less commuter trips. The graphs in these cases are flat and do not show high peaks.

Transit Services

CalTrain Service:

Currently, the CalTrain commuter rail system operating between San Francisco and San Jose terminates at the Cahill station located just south of Santa Clara Street. On weekdays 27 trains operate from San Francisco to San Jose and 26 trains operate from San Jose to San Francisco. The weekday service runs between 5 AM and 10 PM for both the northbound and southbound directions. On Saturdays, twelve trains operate in each direction; on Sundays, nine trains provide service. The majority of the trains stop at all the existing 27 stations along the Peninsula to pickup and discharge passengers.

Due to its close proximity to Site A, the Cahill station offers an excellent opportunity to provide service for the arena patrons to and from the Peninsula cities. Also, during events, if demand dictates, it is possible to provide a special train service similar to the one now provided for events at the Stanford Stadium. Without major changes to the existing services, it was estimated that 5% of the arena patrons from the Peninsula Market area would use CalTrain service. For the 17,500 and 20,000 attendance levels, this would amount to 1.6% of the arena patrons using the Caltrain service.

Studies are underway to investigate extending BART service to the South Bay. Although these studies are in the preliminary stages, it is likely that BART will be extended to San Jose. The Cahill station is a strong candidate for a BART station. However, for the traffic analysis BART usage by arena patrons was not assumed.

Light Rail Service:

The Guadalupe Light Rail (LRT) line is currently under construction. This LRT line will connect downtown San Jose with south San Jose and the City of Santa Clara. Several LRT stations are proposed in the downtown transit mall area. The potential connection of the Guadalupe LRT line with the Cahill CalTrain station is currently being studied. Such a connection would attract a larger number of transit patrons via the LRT service from south San Jose to Site A. It should be noted that for the traffic analysis LRT usage by arena patrons was not assumed.

Road System Improvements

Major transportation system improvements are planned for the area serving Site A. The Route 87/Guadalupe Parkway construction through Downtown San Jose is the major road improvement project currently underway and will be completed by mid to late 1988. As part of this construction project, Route 87 will be extended as a freeway between I-280 and West Taylor Street. According to the design plans, a northbound on-ramp and a southbound off-ramp will be constructed at Park Avenue. A northbound off-ramp will be constructed at West Santa Clara Street. A complete interchange will be constructed between Route 87 and Julian Street. Also, a northbound on-ramp and a southbound off-ramp have been constructed at Coleman Avenue. Within the context of the Route 87 construction project a new street connection will be provided to connect Pleasant Street with Santa Teresa Street (under existing conditions, Santa Teresa is referred to as N. Almaden) from Julian to Santa Clara under Route 87. Once the freeway and its interchanges are completed, Delmas Avenue will be converted to one-way southbound between Santa Clara Street and Auzerais Avenue and will connect with a southbound on-ramp to Route 87.

The construction of Route 87 will not only add significant road capacity for regional connections to downtown, it will also enable the construction of 320 parking spaces underneath the structure south of Santa Clara Street. This parking resource will be very useful for Site A due to its close proximity to the site.

The recently completed Guadalupe River Park Plan recommends a new roadway facility called River Front Road to be located west of and parallel to the Guadalupe River between Coleman Avenue and Santa Clara Avenue. This is proposed to be a four-lane roadway with signals at Coleman Avenue, Julian Street, and Santa Clara Street. This roadway has been adopted in the city's General Plan. However, at this time, it has not been funded; therefore, its time of completion is not known. With the completion of River Front Road, the existing Montgomery/Autumn one-way couplet between Santa Clara and Julian will be eliminated and will be replaced by River Front Road.

3.2 1991 Base Conditions

It is anticipated that 1991 is the year for the opening of the proposed arena development. Therefore, the traffic analysis was completed for Year 1991 conditions.

Intersection Operation

For the five scenarios studied, existing traffic volumes at the twenty critical intersections were factored by an annual growth rate of 1.2 percent to Year 1991. This growth rate reflects the annual increase in the regional background traffic anticipated between now and 1991. Also, the anticipated traffic volumes from future projects in the site vicinity which have been approved were added to the factored traffic volumes. This provided Year 1991 base traffic volumes.

Year 1991 (Base Conditions) Level of Service:

The results of the level of service calculations performed for Year 1991 base traffic conditions are summarized in Table 9. These traffic volumes do not include any project traffic. The purpose of analyzing Year 1991 base conditions is to determine

TABLE 9
1991 BASE CONDITION INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	E	.992	A	.320	A	.149	B	.600		N.A. /c/
Stockton & Taylor	A	.517	A	.122	A	.060	A	.287		N.A.
Coleman & Taylor	D	.842	A	.139	A	.098	A	.294		N.A.
S.R. 87 & Taylor	D	.813	A	.361	A	.137	A	.484		N.A.
S.R. 87 Off-Ramp (SB) & Coleman	A	.779	A	.578	A	.156	A	.514		N.A.
San Pedro & Julian	E/d/		C		A		E		A	
Market & Julian	E	.942	A	.430	A	.196	A	.449	A	.314
Alameda & Julian/Hanchett	D	.838	A	.310	A	.154	A	.459	A	.283
Stockton & Julian	F	1.118	A	.285	A	.200	A	.549	A	.253
Montgomery & Julian	C	.716	A	.159	A	.078	A	.375		
S.R. 87 On-Ramp (SB) & Julian	A	.344	A	.217	A	.088	A	.266	A	.139
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	C	.707	A	.352	A	.076	A	.262	A	.145
Alameda/Race & Martin	D	.840	A	.290	A	.136	A	.425	A	.237
Stockton & Alameda	F/d/		A		A		A			N.A.
Cahill & Alameda	C	.709	A	.269	A	.129	A	.344		N.A.
Montgomery & Alameda	A	.583	A	.261	A	.140	A	.346	A	.248
Autumn & Santa Clara	A	.376	A	.154	A	.087	A	.222	A	.126
S.R. 87 Off-Ramp (NB) & Santa Clara	A	.431	A	.206	A	.095	A	.267	A	.139
Santa Teresa (N. Almaden) & Santa Clara	E	.976	A	.337	A	.212	A	.515	A	.288
Notre Dame & Santa Clara	C	.733	A	.272	A	.165	A	.461	A	.265

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections

the operating level of the studied intersections prior to the addition of the arena-generated traffic for Year 1991. The number of intersections which would operate under unacceptable conditions for each of the time scenarios analyzed are provided below:

— Weekday PM peak hour: 6 intersections

— Weekday Evening peak hour: None

— Weekday Late Evening peak hour: None

— Friday Evening peak hour: 1 intersection

— Saturday Evening peak hour: None.

The results indicate that two of the six intersections that will operate under unacceptable conditions are not under signal control. The other four intersections will operate under LOS E or F conditions during the PM peak hour. The remaining intersections will all be operating at LOS D or better for all the time scenarios. In fact, with the exception of one intersection (Julian and San Pedro), all other intersection locations will be operating at Level of Service A or B during the evening peak hours. This indicates ample spare capacity will be available to serve arena project traffic during those times.

3.3 Year 1991 Base Plus Project Conditions

In this study analyses were conducted for two different seating capacities: 17,500 seats and 20,000 seats. For both cases, maximum attendance was assumed.

Trip Generation

The arena trip generation estimates for each of the two seating capacities are given in Table 10. These numbers are based on the following assumptions:

— Estimated Transit use: 2% by buses, 5% of Peninsula residents by CalTrain.

— An average of 3.0 persons per car.

— The arena events will start at 7:30 PM.

— About 4% of the patrons will arrive during the PM peak hour.

— An estimated 93% will arrive between 6:30 PM and 7:30 PM.

— An estimated 93% of the patrons will leave the arena during the hour immediately after the event.

TABLE 10
TRIP GENERATION FOR ARENA

Site	Average Peak Attendance	Transit (Person Trips)	Automobile (Vehicle Trips)
A	17,500	625	5,620
A	20,000	710	6,430

The traffic analysis is based on the assumption that 96% of the arena patrons would arrive by car and would park at the available parking facilities within an acceptable walking distance from Site A.

Automobile Trip Distribution and Assignment

Year 1995 projected population statistics for the South Bay area were used to determine the market area for the arena sites. The economic consultants[4] provided the projected population for each geographic segment of the market area. The population information was extracted from year 1985 projections produced by the Association of Bay Area Governments. The automobile trip distribution was based on the percentages shown on Figure 24, which gives the percentage of the total arena trips estimated to use each of the regional facilities. The majority of the arena patrons is expected to use regional freeway facilities for obtaining access to the site area. However, in this study it was assumed that some traffic would use the local facilities. An estimated 5% of the project traffic was assigned on the Alameda, 7% on Coleman Avenue, 2% on Julian Street/St. James Street, 2% on Santa Clara Street, 5% on Market Street, 1% on Almaden Boulevard, 7% on Autumn/Montgomery, 1% on Race Street, 1% on Hanchett Avenue, and 2% on Naglee Avenue.

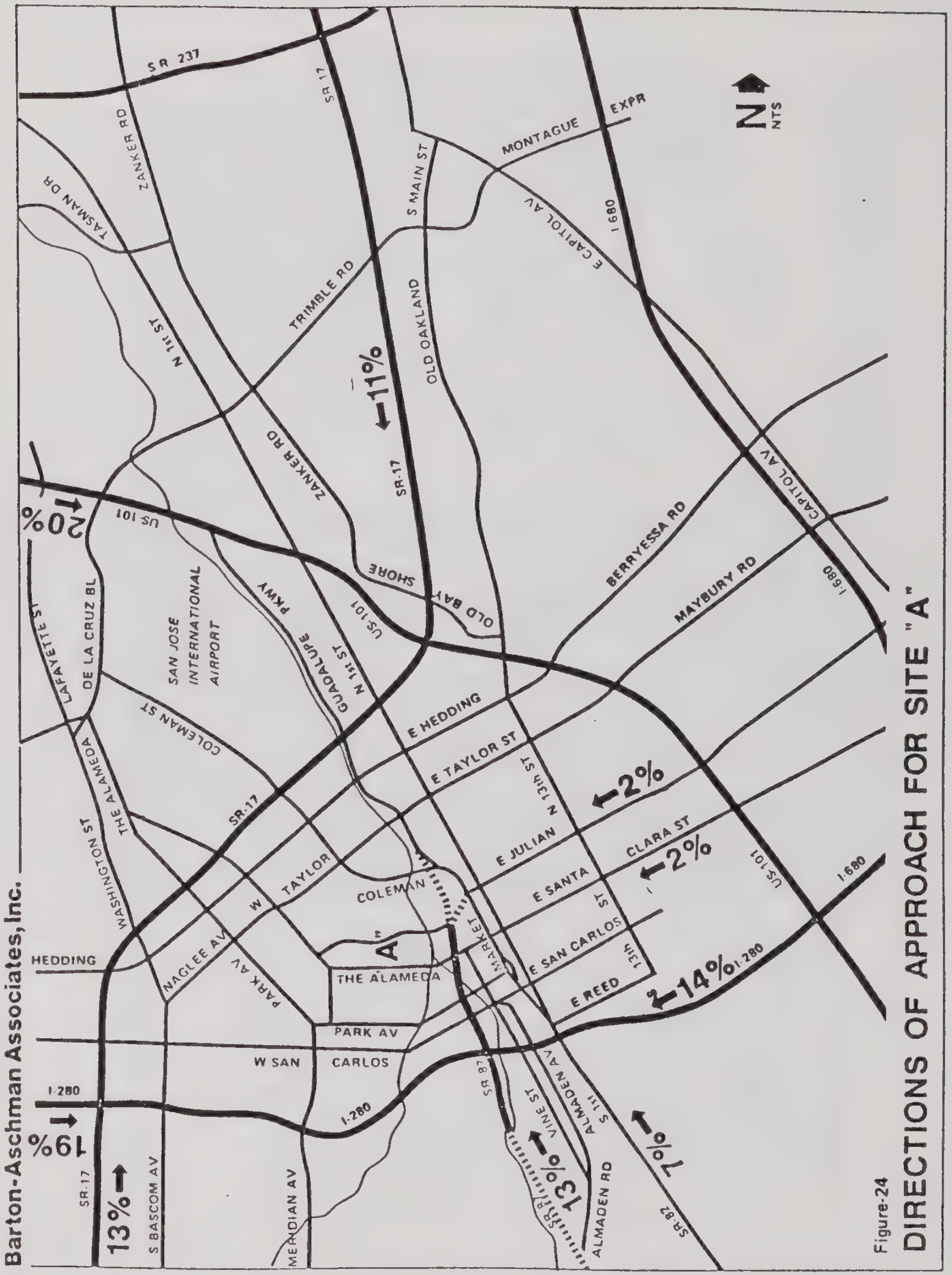
The estimated automobile trips were distributed and assigned to the regional and local roadways approaching the proposed arena site. The trip assignments on the street system in the vicinity of the site were based on the parking facility locations and their walking distances to Site A. The details of this procedure are outlined in Chapter 2 under the Parking Section. The resulting PM peak, evening peak, and late evening peak hour traffic assignments were used to determine the traffic impact of the arena project.

Intersection Operation

Year 1991 (with Project) Level of Service:

The intersection level of service calculation results for both seating capacities (i.e. 17,500 seats and 20,000 seats) with maximum attendance are presented in Tables 11 and 12. The number of intersections that would operate under unacceptable conditions is the same for both attendance levels. They are given below:

4 Economics Research Associates



Barton-Aschman Associates, Inc.

Figure-24
DIRECTIONS OF APPROACH FOR SITE "A"

TABLE 11
1991 WITH PROJECT (CAPACITY: 17,500 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	F	1.068	A	.434	A	.241	B	.600		N.A. /c/
Stockton & Taylor	B	.610	A	.146	A	.083	A	.287		N.A.
Coleman & Taylor	D	.896	A	.207	A	.246	A	.356		N.A.
S.R. 87 & Taylor	F	1.095	B	.635	A	.137	C	.795		N.A.
S.R. 87 Off-Ramp (SB) & Coleman	D	.837	B	.635	A	.219	A	.570		N.A.
San Pedro & Julian	E/d/		B		A		E		B	
Market & Julian	F	1.046	A	.520	A	.247	A	.537	A	.388
Alameda & Julian/Hanchett	E	.918	A	.396	A	.263	A	.552	A	.367
Stockton & Julian	F	1.331	A	.494	A	.308	C	.763	A	.463
Montgomery & Julian	F/e/	N.A.		N.A.	A	N.A.		N.A.		N.A.
S.R. 87 On-Ramp (SB) & Julian	E	.995	C	.712	A	.517	C	.761	B	.643
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	E	.925	A	.364	B	.680	A	.276	A	.364
Alameda/Race & Martin	D	.861	A	.403	A	.163	A	.507	A	.403
Stockton & Alameda	F/d/		B		A		A			N.A.
Cahill & Alameda	E/e/	N.A.		N.A.	A/e/	N.A.		N.A.		N.A.
Montgomery & Alameda	F/e/	N.A.		N.A.	A/e/	N.A.		N.A.		N.A.
Autumn & Santa Clara	B/e/	N.A.		N.A.	B/e/	N.A.		N.A.		N.A.
S.R. 87 Off-Ramp (NB) & Santa Clara	F	1.213	E	.987	A	.343	F	1.021	C	.757
Santa Teresa (N. Almaden) & Santa Clara	F	1.421	C	.778	A	.533	E	.959	C	.730
Notre Dame & Santa Clara	D	.870	B	.618	A	.498	B	.692	A	.538

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections
/e/ Worst Intersection Level of Service Represented Among all Parking Alternatives

TABLE 12
1991 WITH PROJECT (CAPACITY: 20,000 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	F	1.077	A	.452	A	.255	B	.603		N.A. /c/
Stockton & Taylor	B	.610	A	.146	A	.083	A	.287		N.A.
Coleman & Taylor	E	.912	A	.226	A	.266	A	.374		N.A.
S.R. 87 & Taylor	F	1.130	C	.732	A	.137	D	.835		N.A.
S.R. 87 Off-Ramp (SB) & Coleman	D	.813	B	.653	A	.236	A	.587		N.A.
San Pedro & Julian	E/d/		B		A		E		A	
Market & Julian	F	1.070	A	.543	A	.260	A	.559	A	.412
Alameda & Julian/Hanchett	E	.938	A	.400	A	.279	A	.554	A	.370
Stockton & Julian	F	1.336	A	.499	A	.325	C	.767	A	.467
Montgomery & Julian	F/e/	1.006		N.A	A	.233		N.A.		N.A.
S.R. 87 On-Ramp (SB) & Julian	F	1.081	D	.803	A	.532	D	.853	C	.736
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	E	.925	A	.364	D	.859	A	.441	A	.323
Alameda/Race & Martin	D	.864	A	.535	A	.167	A	.532	A	.400
Stockton & Alameda	F/d/		B		A		A			N.A.
Cahill & Alameda	E/e/	.939		N.A.	A/e/	.325		N.A.		N.A.
Montgomery & Alameda	F/e/	1.79		N.A.	B/e/	.669		N.A.		N.A.
Autumn & Santa Clara	B/e/	.693		N.A.	B/e/	.669		N.A.		N.A.
S.R. 87 Off-Ramp (NB) & Santa Clara	F	1.256	E	.998	A	.343	F	1.059	E	.900
Santa Teresa (N. Almaden) & Santa Clara	F	1.537	D	.898	A	.534	F	1.075	D	.848
Notre Dame & Santa Clara	E	.952	B	.645	A	.503	C	.718	B	.616

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections
/e/ Worst Intersection Level of Service Represented Among all Parking Alternatives

- Weekday PM peak hour: 14 intersections (for 17,500 persons attendance level)
  17 intersection (for 20,000 persons attendance level)
- Weekday Evening peak hour: 1 intersection
- Weekday Late Evening peak hour: None
- Friday Evening peak hour: 3 intersections
- Saturday Evening peak hour: 1 intersection

When these results are compared with the results from Year 1991 base conditions (without the arena traffic), it is observed that five intersections would already operate under unacceptable conditions during the PM peak hour and one intersection during the evening peak hours. The remaining intersections would deteriorate to LOS E or F conditions with the addition of the arena traffic.

According to the City of San Jose policy, the traffic impact of a project at an intersection is considered significant and therefore will require mitigation(s) if either one of two following conditions occur:

1. The level of service of an intersection deteriorates from an acceptable level (LOS A, B, C, or D) to an unacceptable level (LOS E or F) after the addition of the project traffic, or

2. For an intersection operating at an unacceptable level of service prior to the addition of the project traffic, the proposed project increases the critical base condition traffic volumes by 1% or more.

PM Peak Hour

Among the five time scenarios considered, the PM peak hour is the most critical. This condition would occur at most two or three times a year when the arena events are broadcasted to a nationwide audience.

In this scenario, 93% of the arena traffic is projected to arrive at Site A during the peak PM commute hour. For this reason, 14 intersections would operate at LOS E or F for the condition with maximum attendance of 17,500 persons, and 17 intersections for the condition with maximum attendance of 20,000 persons. Based on the city's Level of Service Policy, all of these intersections would be significantly impacted by the arena project and would require mitigation measures, where possible.

Mitigation measures for these intersections are discussed in Section 3.6.

Evening Peak Hour

In general, the traffic conditions in the site vicinity are worse on a Friday evening than on a typical weekday or Saturday evening. The intersection (S.R. 87 Off-Ramp (NB) & Santa Clara) which would operate under unacceptable conditions during the weekday and Saturday evening peak hours is projected to deteriorate even more on Friday evenings. This is because of the increased activity level of the general area during weekend evenings. The Center for Performing Arts, Montgomery Theatre, and Civic Auditorium are all located in the vicinity of that intersection as well as the

other signalized intersection (i.e. Santa Teresa and Santa Clara) projected to operate under unacceptable conditions.

Potential mitigation measures to improve the intersection operations are discussed in Section 3.6.

Late Evening Peak Hour

Due to the relatively low base traffic volumes on the roadways during this time period the operations of almost all the intersections included in this traffic analysis are well above the minimum acceptable standards, even with 93% of the arena traffic leaving the site within the hour after the end of the event.

3.4 Year 2000 Base Conditions

The traffic impact analysis for the Year 2000 was conducted to determine the long term impact of the arena project. An analysis of this type requires a reliable long range forecast of background traffic.

The City of San Jose has developed and calibrated a travel demand model for the Year 2000. This model was used for forecasting the PM peak hour traffic volumes for the city streets. This model is known as the HORIZON 2000 TRANPLAN model.

This model is based on the TRANPLAN computer software package, which is commonly used for traffic simulation studies for large urban areas such as the City of San Jose. The City's model is a sophisticated analytical tool with more than 600 traffic analysis zones and thousands of network links. It generates, distributes and assigns nearly 500,000 all purpose trips to the road system network for the PM peak hour. During the assignment process this model accounts for traffic congestion by assigning trips so as to minimize travel time on the road network, but also takes into consideration the available road system capacity. Major planning assumptions built into the model for the Year 2000 include the following:

- Calibration of model using Year 1980 census data.
- Year 2000 data generally matched the ABAG 2005 projections.
- Full built-out of the Julian/Stockton Area with 8,000 jobs.
- Full built-out of North San Jose by Year 2000.
- Completion of the following transportation system projects.
  - Construction of Route 87 as a freeway from south San Jose to north of Taylor Street.
  - Expansion of I-280 to 8 lanes from I-880 to Magdalena Avenue.
  - Widening of I-880 to 6 lanes north of U.S. 101.
  - Modification of Route 237 to provide 8 lanes (6 lanes plus 2 auxiliary lanes).

— Construction of River Front Road between Coleman Road and Santa Clara Street.

o Increased diversion to transit and carpools, with an expanded countywide HOV lane program, which includes I-280, U.S. 101 and Route 237, San Tomas Expressway, Capital Expressway, Montague Expressway, Lawrence Expressway, and Central Expressway.

The city's traffic model, described above, was utilized for estimating the Year 2000 base traffic volumes in the vicinity of Site A. The model run used assumed that the Julian/Stockton area will be redeveloped with Research and Development, and office type of land uses. This model run assumed no development(s) on Site A.

Different factors were applied to the PM peak hour traffic volumes produced by the city's traffic model for projections of traffic volumes during the other time periods under study. These peak hour factors were developed from the twenty-four hour machine counts taken along various roadway facilities in the project area.

Intersection Operation

Year 2000 (Base Condition) Level of Service:

The projected operation of the intersections in the vicinity of the site is described in Table 13.

The number of intersections that would operate under unacceptable conditions for each of the time scenarios analyzed are as follows.

— Weekday PM peak hour: 4 intersections
— Weekday Evening peak hour: 1 intersection
— Weekday Late Evening peak hour: None
— Friday Evening peak hour: 1 intersection
— Saturday Evening peak hour: None

PM Peak Hour

By Year 2000, even without the arena project, the intersection of S.R. 87 and Taylor would operate at a LOS F (with a V/C ratio = 2.1). This intersection would require major modifications for an efficient and acceptable level of operation. Potential mitigation measures that should be considered, regardless of the status of the arena project, are discussed in Section 3.6.

The other three intersections projected to operate under unacceptable conditions are:

1. Alameda & Julian/Hanchett
2. River Front & Julian
3. Santa Teresa & Santa Clara

3.5 Year 2000 Base Plus Project Conditions

The traffic impacts of the arena project on Year 2000 base traffic conditions were determine for the two attendance levels studied.

TABLE 13
YEAR 2000 BASE CONDITION INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM		WKDY EVE.		WKDY LATE EVE.		FRI. EVE.		SAT. EVE.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C
Alameda & Taylor/Naglee	C	.752	A	.495	A	.183	A	.485	N.A. /c/	
Stockton & Taylor	A	.599	A	.424	A	.198	A	.440	N.A.	
Coleman & Taylor	D	.873	A	.574	A	.268	A	.574	N.A.	
S.R. 87 & Taylor	F	2.139	F	1.633	A	.582	F	1.424	N.A.	
River Front & Coleman	A	.491	A	.327	A	.156	A	.327	N.A.	
S.R. 87 Off-Ramp (SB) & Coleman	A	.381	A	.321	A	.150	A	.253	N.A.	
San Pedro & Julian	N.A.		N.A.		N.A.		N.A.		N.A.	
Market & Julian	C	.737	A	.468	A	.211	A	.468	A	.283
Alameda & Julian/Hanchett	E	.972	A	.522	A	.204	A	.541	A	.292
Stockton & Julian	D	.829	A	.317	A	.126	A	.384	A	.196
River Front & Julian	F	1.168	A	.531	A	.174	B	.614	N.A.	
S.R. 87 On-Ramp (SB) & Julian	B	.668	A	.366	A	.162	A	.423	A	.227
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	A	.553	A	.348	A	.152	A	.358	A	.203
Alameda/Race & Martin	A	.096	A	.061	A	.028	A	.061	A	.037
Stockton & Alameda	A	.525	A	.309	A	.132	A	.342	N.A.	
Cahill & Alameda	N.A.		N.A.		N.A.		N.A.		N.A.	
Montgomery & Alameda	A	.514	A	.311	A	.150	A	.351	N.A.	
River Front & Santa Clara	C	.724	A	.448	A	.214	A	.488	A	.293
S.R. 87 Off-Ramp (NB) & Santa Clara	A	.386	A	.234	A	.114	A	.265	A	.137
Santa Teresa (N. of Almaden)& Santa Clara	F	1.104	B	.656	A	.301	C	.750	A	.416
Notre Dame & Santa Clara	B	.622	A	.385	A	.171	A	.441	A	.230

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed

Intersection Operation

Year 2000 (With Project) Level of Service:

The intersection level of service calculation results for both seating capacities (i.e. 17,500 seats and 20,000 seats) with maximum attendance are presented in Tables 14 and 15.

The number of intersections which would operate under unacceptable conditions are as follows:

— Weekday PM peak hour: 9 intersections (for 17,500 persons attendence level)
 10 intersections (for 20,000 personsattendance level)
— Weekday Evening peak hour: 3 intersections
— Weekday Late Evening peak hour: None
— Friday Evening peak hour: 3 intersections
— Saturday Evening peak hour: None (for 17,500 persons attendance level)
 2 intersections (for 20,000 persons attendance level)

When these results are compared with the results from Year 2000 base conditions (without the arena project), it is observed that four intersections would already operate under unacceptable conditions during the PM peak hour and one intersection during the evening peak hours prior to the addition of the arena traffic through these intersections. The remaining intersections would deteriorate to LOS E or F conditions with the addition of the arena traffic.

PM Peak Hour

Up to 10 intersections (only 9 intersections for the 17,500 persons attendance level) would operate at LOS E or F during the PM peak hour. For all 10 intersections, the impact of the arena traffic on the base conditions are considered significant by the city's Level of Service Policy.

Mitigations to improve their operations are discussed in Section 3.6.

Evening Peak Hour

The intersection of S.R. 87 and Taylor would require modifications, with or without the arena project, to improve not only its PM peak hour operation but its evening peak hour operations as well.

The two other intersections which would operate under LOS F conditions are:

1. S.R. 87 Off-Ramp (NB) & Santa Clara
2. Santa Teresa & Santa Clara

Mitigation measures to improve their operation are discussed in Section 3.6.

TABLE 14
2000 WITH PROJECT (CAPACITY: 17,500 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM		WKDY EVE.		WKDY LATE EVE.		FRI. EVE.		SAT. EVE.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C
Alameda & Taylor/Naglee	C	.791	A	.598	A	.295	A	.588	N.A. /c/	
Stockton & Taylor	B	.664	A	.424	A	.186	A	.440	N.A.	
Coleman & Taylor	E	.984	B	.692	A	.291	B	.692	N.A.	
S.R. 87 & Taylor	F	2.104	F	1.628	A	.582	F	1.628	N.A.	
River Front & Coleman	C	.714	A	.539	A	.336	A	.539	N.A.	
S.R. 87 Off-Ramp (SB) & Coleman	A	.381	A	.253	A	.120	A	.253	N.A.	
San Pedro & Julian	N.A.		N.A.		N.A.		N.A.		N.A.	
Market & Julian	C	.762	A	.495	A	.211	A	.495	A	.310
Alameda & Julian/Hanchett	F	1.055	B	.678	A	.322	B	.698	A	.407
Stockton & Julian	E	.926	A	.520	A	.251	B	.607	A	.361
River Front & Julian	F/d/		N.A.		N.A.		N.A.		N.A.	
S.R. 87 On-Ramp (SB) & Julian	E	.932	B	.621	B	.648	B	.677	A	.586
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	C	.776	A	.348	D	.801	A	.358	A	.318
Alameda/Race & Martin	B	.584	A	.431	A	.148	A	.423	A	.282
Stockton & Alameda	B	.624	A	.410	A	.221	A	.442	N.A.	
Cahill & Alameda	N.A.		N.A.		N.A.		N.A.		N.A.	
Montgomery & Alameda	F/d/	N.A.	N.A.		N.A.		A/d/		N.AN.A.	
River Front & Santa Clara	F/d/	N.A.	N.A.		N.A.		N.A.		N.A.	
S.R. Off-Ramp (NB) & Santa Clara	F	1.107	E	.962	A	.374	E	.987	D	.897
Santa Teresa (N. Almaden) & Santa Clara	F	1.559	F	1.170	B	.661	F	1.265	D	.870
Notre Dame & Santa Clara	D	.874	B	.689	A	.512	C	.749	A	.471

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Intersection Level of Service Represented

TABLE 15
2000 WITH PROJECT (CAPACITY: 20,000 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	C	.795	B	.613	A	.308	B	.606	N.A.	
Stockton & Taylor	B	.667	A	.426	A	.188	A	.443	N.A.	
Coleman & Taylor	F	1.000	C	.709	A	.309	C	.709	N.A.	
S.R. 87 & Taylor	F	2.101	F	1.639	A	.582	F	1.639	N.A.	
River Front & Coleman	C	.714	A	.539	A	.365	A	.539	N.A.	
S.R. 87 Off-Ramp (SB) & Coleman	A	.381	A	.253	A	.120	A	.253	N.A.	
San Pedro & Julian	N.A.		N.A.		N.A.		N.A.		N.A.	
Market & Julian	C	.767	A	.499	A	.211	A	.499	A	.314
Alameda & Julian/Hanchett	F	1.077	B	.699	A	.336	C	.718	A	.428
Stockton & Julian	E	.930	A	.521	A	.269	B	.611	A	.364
River Front & Julian	F/d/	1.536	N.A.		N.A.		N.A.		N.A.	
S.R. 87 On-Ramp (SB) & Julian	F	1.028	C	.798	B	.648	C	.798	B	.672
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	C	.776	A	.530	D	.892	A	.541	A	.356
Alameda/Race & Martin	B	.609	A	.456	A	.152	A	.448	A	.307
Stockton & Alameda	B	.646	A	.433	A	.237	A	.465	N.A.	
Cahill & Alameda	N.A.		N.A.		N.A.		N.A.		N.A.	
Montgomery & Alameda	F/d/	1.219	N.A.		A/d/	.503	N.A.		N.A.	
River Front & Santa Clara	F/d/	1.438	N.A.		B/d/	.695	N.A.		N.A.	
S.R. Off-Ramp (NB) & Santa Clara	F	1.152	F	1.028	A	.530	F	1.052	E	.965
Santa Teresa (N. Almaden) & Santa Clara	F	1.724	F	1.273	B	.671	F	1.369	F	1.031
Notre Dame & Santa Clara	E	.958	C	.702	A	.517	C	.759	A	.548

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Intersection Level of Service Represented

3.6 Transportation Mitigations

The required transportation-related improvements for Year 1991 and Year 2000 are outlined below by time scenarios. The intersections which could not be mitigated due to physical constraints are indicated as well.

Year 1991

PM Peak Hour:

1. Alameda and Taylor/Naglee Intersection

Under projected 1991 base conditions this intersection would operate at LOS E (V/C = .992). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.077) for the maximum attendance level.

Under existing conditions, there exists two through lanes in both the northbound and southbound directions. It is recommended that the intersection be restriped and reconstructed to provide an additional lane in both directions. This would require parking prohibitions on both sides of Alameda and improve the projected LOS to D (V/C = .892).

2. Coleman and Taylor Intersection

This intersection is projected to operate at a level worse than D only for the maximum attendance level of 20,000 persons. For this condition, the intersection would operate at LOS E (V/C = .912).

Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection.

3. S.R. 87 and Taylor Intersection

Under projected 1991 base conditions, this intersection would operate at LOS D (V/C = .842). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.130) for the maximum attendance level.

It is recommended that this intersection be grade-separated with ramps constructed to permit all turning movements.

4. San Pedro and Julian Intersection

Currently this intersection is controlled with STOP signs for San Pedro traffic. Under existing conditions and Year 1991 PM peak hour traffic conditions, this intersection is and would continue to operate below LOS D if it remains unsignalized.

Due to its downtown location , this intersection is exempted from the City of San Jose's Level of Service Policy. Even so, it is recommended that a signal be installed at this intersection. Implementation of this mitigation measure would not only improve the operation of this intersection during the PM peak hour, but during the evening peak hours as well.

5. Market and Julian Intersection

Under projected 1991 base conditions, this intersection would operate at LOS E (V/C = .942). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.070) for the maximum attendance level.

Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection.

6. The Alameda and Julian/Hanchett Intersection

Under existing conditions, the Julian and Hanchett legs of this intersection are offset from one another. With the arena traffic included, the operation of this intersection would deteriorate from LOS D (V/C = .838) to LOS E (V/C = .938).

To improve the operation of this intersection during this time period, it is recommended that a barrier median be constructed on Alameda across its intersection with Hanchett. This barrier median extension will result in additional storage capacity for left-turning vehicles. Implementation of this mitigation measure will restrict the movements on Hanchett Avenue to include only right-turns in and out of this intersection. In addition, it is recommended that an island be constructed on the Hanchett leg. This will assist drivers and provide them with a clear indicator of the permitted movements.

Implementation of this improvement would improve the intersection operation to a LOS C (V/C = .773).

7. Stockton and Julian Intersection

Under projected 1991 base conditions, this intersection would oeprate at LOS F (V/C = 1.118). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.336) at maximum attendance level.

In order to improve the operation of this intersection during this time period, it would be necessary to reconstruct this intersection to provide the following lane geometrics:

north approach: an exclusive right-turn lane, an exclusive through lane, a shared through and left-turn lane, and an exclusive left-turn lane.

west approach: a shared through and right-turn lane and a shared through and left-turn lane.

Implementation of these mitigation measures would require land acquisition and the widening of the Julian underpass to provide a four-lane cross-section. With these improvements, the projected intersection LOS would improve from LOS F (V/C = 1.336) to LOS D (V/C = .826).

8. Montgomery and Julian Intersection

Under projected 1991 base conditions, this intersection would operate at LOS C (V/C = .716). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.006) at the maximum attendance level.

It is recommended that the west approach of this intersection be widened to provide an additional right-turn lane. This proposed mitigation would require some land acquisition.

The south leg of this intersection would have direct access to the patron parking area for Site A. This roadway segment would need to be modified to accommodate two-directional traffic flow, with some flexibility in terms of lane arrangements during the evenings when arena events are held.

9. S.R. 87 On-Ramp (SB) and Julian Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy due to its downtown location. Even so, it is recommended that the approach (i.e. southbound off-ramp) be widened to provide an additional through lane. This would improve the intersection operation from LOS F (V/C = 1.028) to LOS D (V/C = .834). The off-ramp would have adequate storage space to accommodate the projected traffic volumes.

10. S.R. 87 On-Ramp (NB)/Notre Dame and Julian Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy. With the arena traffic included, this intersection is projected to operate at LOS E (V/C = .925). For the two or three times during the year when events start at 6:00 PM the operation of this intersection would remain below acceptable standards. The maximum back of queue estimated for the off-ramp traffic extends 200 feet south of the nose of the off-ramp.

11. Stockton and Alameda Intersection

Currently Stockton Street intersects with The Alameda at an acute angle just west of the Southern Pacific/Julian Street underpass. The intersection is controlled by a STOP sign for Stockton traffic. Under existing as well as the 1991 PM peak hour traffic conditions this intersection is and would continue to operate below Level of Service D if it remains unsignalized.

Therefore, it is recommended that this intersection be signalized. If right-of-way permits, Stockton Street should be realigned to improve visibility.

12. Cahill and Alameda Intersection

Under projected 1991 base conditions, this intersection would operate at LOS C (V/C = .709). With the arena traffic included, the intersection operation would deteriorate to LOS E (V/C = .939) at the maximum attendance level.

In order to improve the operation of this intersection during this time period it would be necessary to restripe and reconstruct this intersection to provide the following lane geometrics:

south approach: an exclusive right-turn lane, a through lane and a left-turn lane.

With this restriping scheme, the operation of this intersections would remain at LOS E (V/C = .939).

13. Montgomery and Alameda Intersection

This intersection would operate at LOS F (V/C = 1.79) at the maximum attendance level of 20,000 persons. This poor level of service reflects the large number of vehicles projected for the left-turn movement from the east on Santa Clara to the south on Montgomery.

It is recommended that Autumn operate as a two-directional roadway between Julian and San Fernando. Implementation of this improvement measure would improve the projected intersection operation of Montgomery and Alameda to a LOS F (V/C = 1.122). In addition, it is recommended that the east approach of Montgomery and Alameda be restriped to provide an exclusive left-turn lane, a shared left-turn and through lane, and an exclusive through lane. Also, an additional eastbound through lane should be provided through this intersection.

With these improvements, this intersection would operate under acceptable conditions.

14. Autumn and Santa Clara Intersection

If Autumn operates as a two-directional roadway through this intersection in 1991, it is recommended that the intersection have the following lane geometrics:

north approach: an exclusive right-turn lane, a shared through and left-turn lane.

east approach: an exclusive right-turn lane, a shared through and right-turn lane, an exclusive through lane, and an exclusive left-turn lane.

south approach: a shared through and right-turn lane, an exclusive through lane, and a shared through and left-turn lane.

west approach: an exclusive right-turn lane, a shared through and right-turn lane, an exclusive through lane, and an exclusive left-turn lane.

With these lane configurations, the intersection would operate at LOS F (V/C = 1.00) for the PM peak hour analysis.

15. S.R. 87 Off-Ramp (NB) and Santa Clara Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy due to its downtown location. It should be noted that with the arena traffic, the LOS of this intersection at maximum attendance level is projected to be F (V/C = 1.256). During the two or three days of the year when arena events are held beginning at 6:00 PM, serious operational problems with long queues and delays would occur at this intersection. The maximum back of queue estimated for the off-ramp traffic extends 200 feet south of the nose of the off-ramp.

16. Santa Teresa and Santa Clara Intersection

This intersection is exempted from the City of San Jose's level of service policy due to its downtown location. Even so, the following mitigation measures are recommended:

westbound: the segment of roadway between Notre Dame and Santa Teresa be restriped to provide an additional westbound through lane.

eastbound: the segment of roadway between the off-ramp and Terraine be restriped to provide an additional eastbound through lane.

Both of these measures would require parking prohibitions.

Implementation of this mitigation measure would improve the operation of the intersection of Santa Teresa and Santa Clara from LOS F (V/C = 1.537) to LOS F (V/C = 1.199).

Due to physical constraints, no additional mitigation measures are possible at this intersection. When the arena events are held beginning at 6:00 PM, serious operational problems with long queues and delays would occur at this intersection.

17. Autumn and Julian Intersection

It is recommended that the east approach of this intersection be reconstructed to provide an exclusive left-turn lane and the west approach an exclusive right-turn lane. Autumn Street, south of Julian, should have four lanes with two in each direction. Some flexibility in terms of lane arrangements during the time periods when arena events are held would be required.

These improvements may require land acquisitions.

18. It is assumed that all the signalized intersections would be operating under optimal signal phasing plan for Year 1991 and Year 2000.

Evening Peak Hours:

1. Santa Teresa and Santa Clara Intersection and S.R. 87 and Off-Ramp (NB) and Santa Clara

As indicated earlier, it is recommended that the roadway segment between the off-ramp and Santa Teresa be restriped to provide an additional eastbound and westbound through lane. This restriping would require parking prohibitions.

Implementation of this mitigation measure would improve the operation of the intersection of Santa Teresa and Santa Clara from LOS F (V/C = 1.075) to LOS E (V/C = .903).

The intersection of S.R. 87 off-ramp (NB) with Santa Clara is projected to operate at LOS F (V/C = 1.059). This condition is caused by the heavy arena traffic using this ramp to obtain access to the several parking facilities on Santa

Clara Street. In reality, the future conditions at this ramp intersection during the evening peak hours may not be as bad as the numbers suggest. Since the operation of the next S.R. 87 off-ramp just north of this one is well above the minimum standard acceptable it is likely that the arena patrons intending to use the more convenient off-ramp would opt to use this off-ramp instead. Increased usage of the S.R. 87 off-ramp at Julian would improve the LOS for the off-ramp at Santa Clara from LOS F (V/C = 1.059) to LOS C (V/C = .777) for the Friday evening peak hour conditions.

Year 2000

In addition to the mitigation measures already mentioned, the following improvements are recommended for implementation.

PM Peak Hour

1. S.R. 87 and Taylor Intersection

This intersection has already been discussed under Year 1991. However, it should be noted that for Horizon Year 2000, with or without the arena project, major modifications will be required to improve the intersection operation from its projected LOS F (with V/C = 2.1).

Therefore, the previously recommended improvement that the intersection be grade-separated with ramps constructed to permit all turning movements would be necessary to accommodate the projected Year 2000 base traffic volumes.

2. River Front and Julian Intersection

The following lane geometrics are recommended for this intersection:

north approach: an exclusive left-turn lane, a shared left-turn and through lane and a shared right-turn and through lane.

east approach: an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.

south approach: an exclusive left-turn lane, an exclusive through lane, and a shared through and right-turn lane.

west approach: an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.

With these lane geometrics, the intersection would operate at a LOS E (V/C = .910) for Year 2000 PM peak hour conditions with an arena starting time of 6:00 PM. This proposed mitigation would require land acquisitions and major reconstruction.

3. River Front and Santa Clara Intersection

With the arena development, there would be increased traffic volumes through this intersection.

It is recommended that the north approach be widened to provide an additional lane. The lane striping on this approach should be as follows: an exclusive left-turn lane, an exclusive through lane and a shared through and right-turn lane.

With these lane configurations, the intersection would operate at LOS D (V/C = .894).

Evening Peak Hours:

1. River Front and Santa Clara Intersection

Please refer to the discussion on mitigations for this intersection provided under Year 2000 PM peak hour section.

Transit Service Improvements

In addition to the mitigations discussed in the previous section, improvements in transit service to/from the site would also improve the traffic conditions on the streets and at intersections in the site vicinity. Three ways to improve the transit service to/from the arena site include:

1. Provide additional trains (CalTrain Service) for the peak direction of travel immediately before and after the events.

2. Provide an express bus service between Park & Ride Lot locations and the arena site.

3. Run a shuttle bus service between the LRT stations in the downtown area and the arena site.

4.
PEDESTRIAN ANALYSIS

Site A is planned to have more than 70% of its parking needs provided at parking facilities located away from the arena building for the maximum attendance level. This arrangement will require patrons to walk to the arena site. Consequently, it is necessary to assess the existing facilities available to serve pedestrians between the parking areas and the arena. The existing pedestrian facilities may need to be improved to provide safe and convenient pedestrian movement. This chapter assesses the existing conditions and estimates the future pedestrian facility requirements.

4.1 Existing Pedestrian Facilities

There are about ten parking facilities that would serve the arena patrons. All the major parking facilities are located east of the arena site and major pedestrian traffic is expected from these parking areas. Some pedestrian traffic is also expected from the west along The Alameda and Julian Street.

An inventory of the existing pedestrian facilities was conducted along the perceived pedestrian paths between the parking areas and Site A. These include sidewalk widths, pedestrian crosswalks at intersections, traffic regulations, signs, and signal locations with and without pedestrian signal heads. The sidewalk inventory included bus stops, handicap ramps, and the location of sidewalk furniture and other impediments that might restrict sidewalk efficiency. Also, the intersections with heavy traffic volumes and significant pedestrian crossing conflicts were also observed.

The purpose of this inventory was to assess the opportunities and constraints offered by the existing transportation system for pedestrian access and circulation between the major parking areas and the arena. The pedestrian paths between parking facilities and the arena site are shown in Figure 25.

4.2 Sidewalk Analysis

The major pedestrian route leading to the arena will be Santa Clara Street between Market Street and Cahill Steet. The north side of Santa Clara Street has a 12 foot wide sidewalk between Market Street and Autumn Street. On the south side a 12 foot sidewalk extends between Market Street and Almaden Boulevard. On the south side of Santa Clara between Almaden and Autumn the sidewalk is seven feet wide.

As most of the parking garages serving the arena are located along Santa Clara Street, the pedestrians heading towards the arena would congregate on the sidewalks along the street. The arena patrons would walk in platoons. Platoon flow is defined as the bunching of pedestrians because of internal or external impedances.

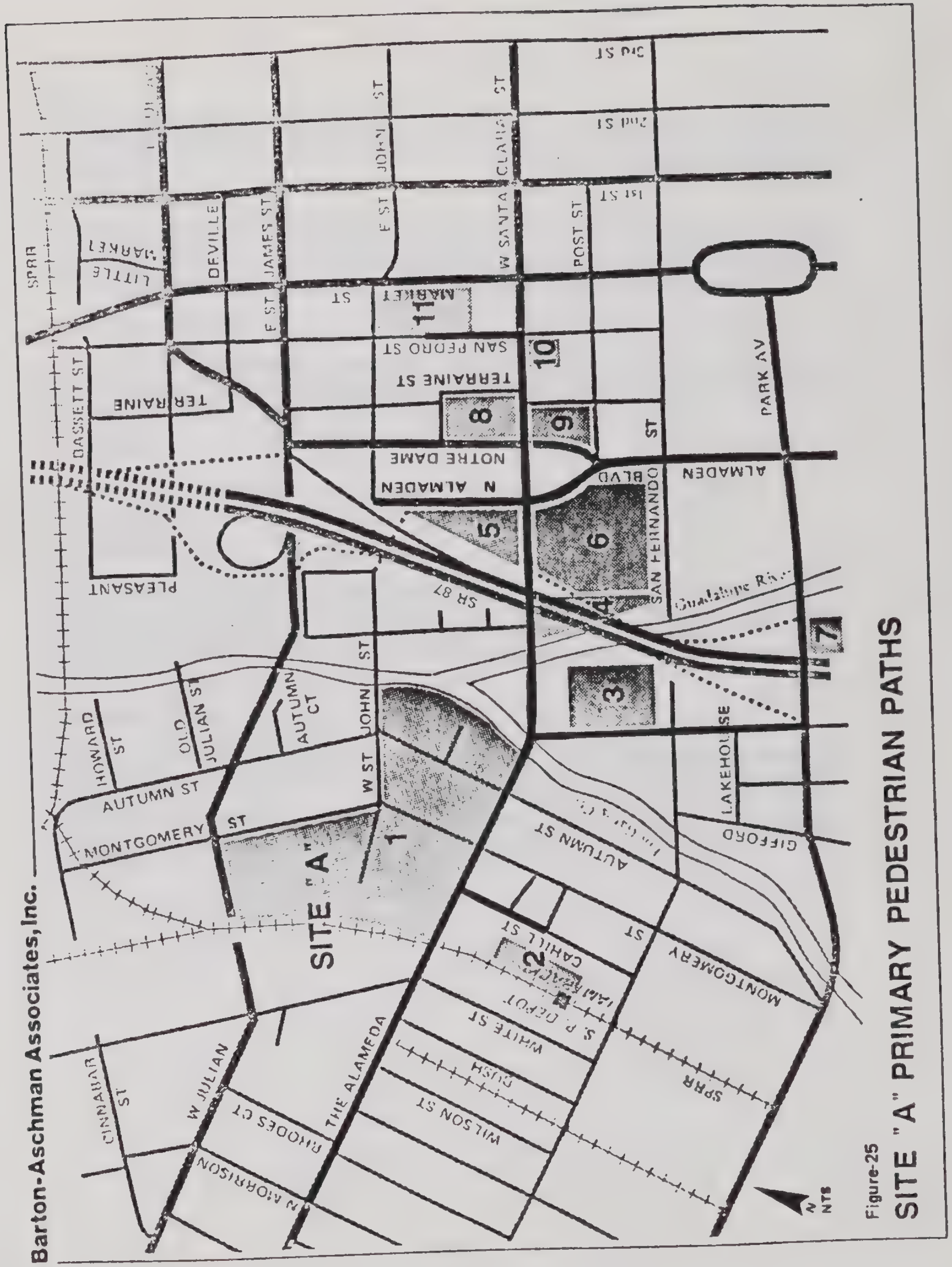


Figure-25
SITE "A" PRIMARY PEDESTRIAN PATHS

Recent research[5] has indicated that the level of service occurring in platoons is generally about one level of service lower than the level indicated based on average flow criteria. In platoon flow behavioral norms will envolve whereby pedestrians may be willing to accept smaller buffer zones at disproportionately higher speeds than indicated by the level of service criteria for average conditions. Based on the recent research it is estimated that for Level of Service "D" a pedestrian flow of about 30 persons per minute per foot width of the sidewalk can be accommodated. Assuming that the 12 foot sidewalk will only have a 10 foot effective width, each side would accommodate 300 pedestrians per minute or 600 on both sides of the street.

According to surveys conducted of arrival patterns for special events, the patrons arrive at different rates per ten minute period. The largest percentage to arrive for entertainment events within a ten minute period was reported to be 24%, which arrived 20 to 30 minutes before the start of the event. For a 20,000 capacity crowd it was estimated that the largest average flow would be 500 pedestrians per minute. Therefore it is estimated that flow would experience a Level of Service "D."

The south side of Santa Clara Street between Almaden and Autumn is only 7 feet wide. It is recommended that during the design of Route 87, construction provisions should be made to allow for the widening of this section of sidewalk from 7 feet to 12 feet. After the arena is in operation, the pedestrian flows should be monitored, and if warranted, the widening should be constructed. The pedestrian flow capacity from the westside on The Alameda is estimated to be about 100 persons per minute.

4.3 Pedestrian Crosswalk Analysis

There are five signalized intersections on Santa Clara Street between Market Street and Almaden Boulevard. Once the Route 87 northbound off-ramp is constructed, another signal will be added on this section of Santa Clara Street. Also, three signalized intersections are located on Santa Clara Street in front of Site A at Autumn Street, Montgomery Street, and Cahill Station.

An inventory was conducted to obtain information regarding the existing traffic signal locations, pedestrian signal head locations, pedestrian crosswalks and availability of handicap ramps at these intersections. This information was used to determine the adequacy of pedestrian movement along Santa Clara Street. Following is a brief description of the opportunities and constraints available on Santa Clara Street.

Traffic Signals:

The existing traffic signals along Santa Clara Street between Market Street and Cahill Street will require new signal phasing and timing plans to accommodate future automobile and pedestrian traffic. The signal timing analysis conducted for the signalized intersections showed that a 90 second cycle will be necessary. Due to heavy pedestrian crossing demand, the timing plans will require longer pedestrian cross times for the east-west-movements. Also, after the completion of the Route 87 off-ramp at

5 Level-of-Service Standards for Platooning Pedestrian in Transportation Terminals. By Dennis G. Davis and John P. Braksima.

Santa Clara Street, it will be necessary to install a traffic signal at that intersection. It should be noted that the heavy pedestrian and vehicular movements would be in the east-west direction. Therefore, no major pedestrian and vehicular conflicts are anticipated.

If the current signal controllers are not capable of having different signal timing plans at different times of the day, a new master controller will be required to interconnect the signals along Santa Clara between Market Street and Cahill Street and provide different signal timing arrangements for different peaks during arena operation.

Pedestrian Signal Heads:

At present all the signalized intersections are equipped with pedestrian signal heads. The new signal at the intersection of Santa Clara Street and Route 87 northbound off-ramp should also include pedestrian signal heads.

Crosswalks:

All signalized intersections are provided with pedestrian crosswalks. Similar crosswalks would be required at the new Route 87 and Santa Clara intersection.

Handicap Ramps:

The intersections along Santa Clara Street between Market Street and Route 87 have ramps for handicapped persons. The Santa Clara street intersections at Delmas Street, Autumn Street, and Montgomery Street do not have ramps. These three intersections and the new intersection of Route 87 and Santa Clara Street should be provided with ramps.

4.4 Street Lighting

Currently there is street lighting on all streets expected to be used by pedestrians to and from the arena and the parking facilities. However, there are certain areas where a higher level of illumination will be required, specifically the section of Santa Clara Street between Market Street and Stockton Street. The plaza area in front of the arena and the east and north sides of the building should also be well illuminated with floodlights to provide a safe environment for pedestrians.

5.

NEIGHBORHOOD IMPACTS

Two types of neighborhood impacts are anticipated if the arena is located on Site A. The first impact is the use of neighborhood streets for parking by arena patrons. The second impact is the infiltration of arena traffic on the surrounding neighborhood streets. Both of these impacts are discussed below. Also, possible solutions to eliminate or minimize these impacts are presented. It should be noted that the parking and traffic impacts on the neighborhoods would vary depending on their distance from the arena site. The residential areas adjacent to the site would experience greater impacts. As the distance between the neighborhoods and the arena site increase, the probability of adverse impacts would decrease. The impacts discussed in this chapter are based on the traffic data collection and analysis performed in Chapter 3.

5.1 Neighborhood Parking Impacts

When an activity center, such as an arena, is introduced within a reasonable walking distance of a residential neighborhood, a certain number of persons will always attempt to park their cars in the neighborhoods to avoid parking costs or traffic congestion. This will occur regardless of how much parking is provided at the activity center.

Strong measures are required to ensure that neighborhood streets do not turn into a parking facility when arena events are taking place.

On-Street Neighborhood Parking

The neighborhood on-street parking inventory and usage survey, discussed in Section 2.1, were conducted to understand the existing parking supply and demand situation. It was not conducted to condone the use of neighborhood streets for parking by arena patrons. The results of the existing parking survey indicate there are available parking spaces in the neighborhoods surrounding Site A. Therefore, arena patrons would attempt to park on the neighborhood streets since these free spaces are conveniently located.

One of the more effective ways to solve the problem of arena patrons parking on neighborhood streets would be to plan, design, and implement a residential permit parking policy for selected areas in the vicinity of the arena site. This plan can be implemented if the neighborhood residents request such a program.

Permit parking is relatively simple to implement and enforce. Residents would be issued parking permits for each registered vehicle plus a visitor parking permit for their private use. The streets would be signed to allow parking only for vehicles displaying permits. Vehicles without permits would be issued a parking ticket and a fine would be imposed for each violation. Very strict enforcement is a key element in making this program a success.

It is strongly recommended that if this site is selected, a residential permit parking plan should be implemented if the residents request such a measure.

Off-Street Neighborhood Parking

In the vicinity of Site A, there exists a few private surface parking lots off of The Alameda west of Stockton Avenue. These lots could potentially provide parking for an estimated 200 automobiles. Although this parking supply was not assumed in this study, the lots were considered in the analysis of potential neighborhood impacts by an arena development on Site A. This potential parking supply could generate up to an estimated 200 trips through the streets serving these lots during the arena peak hour(s) of traffic activity.

This problem of neighborhood parking and the resulting traffic impact can be resolved in two ways. The first method would be to restrict such off-street parking in the residential neighborhoods. The second way is to erect barricades during arena events to eliminate arena traffic from neighborhood streets.

5.2 Neighborhood Traffic Impacts

The automobile traffic to and from the arena is expected to primarily use the major street system. However, some arena patrons would infiltrate the neighborhood streets to circumvent congestion on the major streets or to park on the neighborhood streets or in a neighborhood parking lot. This added traffic will cause inconvenience and annoyance to the residents. A number of neighborhood groups have expressed concerns regarding parking and traffic impacts in their area if the arena is located at Site A.

To alleviate the neighborhood street impacts from the proposed arena site, it is recommended that a commitment be made towards planning, designing, and implementing a neighborhood traffic control program. This program should be implemented only after the arena is in operation and the neighborhoods have been closely monitored to ascertain the amount of infringement of arena traffic on the local residential streets in the vicinity of the arena site.

A neighborhood traffic impact study is being undertaken by the Traffic Operations Department of the City of San Jose at the request of Shasta/Hanchett Park Neighborhood Association. A number of recommendations are being prepared for discussions with the neighborhood group. It is anticipated that these recommendations would be implemented prior to the opening of the arena at Site A.

This neighborhood traffic control program, once implemented, is expected to minimize the cut-through commuter traffic. After the opening of the arena, if it is determined that the arena patrons are utilizing the residential streets, it would be necessary to erect temporary barricades to eliminate this problem during arena operation.

5.3 Conclusions

The construction of a facility such as the arena creates serious traffic and parking concerns for the residents in the surrounding neighborhood.

A full commitment should be made to the neighborhood residents to thoroughly investigate any impacts occurring after the opening of the arena and to implement solutions acceptable to them.

6. CONCLUSIONS

A summary of the recommendations presented in Chapters 2 through 5 are presented below. The basis for these recommendations are a number of conditions and assumptions which were discussed in each of the chapters. If these conditions are satisfied, then the following conclusions are valid.

6.1 Parking

Summary of Analysis

The available parking supply analysis indicated that there would be 7,211 parking spaces available for arena patrons for evening and weekend performances. The parking demand analysis showed that there would be a need for 5,620 spaces for a 17,500 seat arena and 6,430 spaces for a 20,000 seat facility. Therefore, there would be an excess of about 1,600 available parking spaces for arena patrons for the 17,500 seat arena and 780 spaces for the 20,000 seat arena in the general area. This surplus would ensure sufficient parking supply for arena patrons for evening and weekend events.

The weekday afternoon shows would require an estimated 2,610 spaces. All but 270 spaces could be reserved for these events. The several private parking facilities could satisfy the remaining demand of 270 spaces.

Proposed Parking Strategies

The parking demand and supply analysis outlined in Chapter 2 led to the following parking strategy.

1. Site A would provide 2,020 parking spaces on site. These spaces should be reserved for arena patrons only.
2. A comprehensive long term plan should be prepared to provide parking for arena employees at a location away from the site. This arrangement should be strictly enforced.
3. Arrangements should be made to provide parking areas for truck-trailers and rigs used for the arena events, away from the site during the arena performance. This arrangement should be strictly enforced.
4. Arrangements should be made to provide on-site parking for charter buses used by arena patrons.
5. In order to ensure the availability of privately owned parking facilities for arena patrons, arrangements should be made with the owners of these facilities.

5. The parking demand for afternoon matinee events should be monitored closely. If the demand exceeds the supply, arrangements should be made to increase the parking at or near the arena.

6.2 Traffic

The following improvements would be required to mitigate the traffic impact generated by an arena facility located on Site A for Year 1991 and Year 2000.

For Year 1991

1. Alameda and Taylor/Naglee Intersection

   Under existing conditions, there exists two through lanes in both the northbound and southbound directions. It is recommended that the intersection be restriped and reconstructed to provide an additional lane in both directions. This would require parking prohibitions on both sides of Alameda.

2. Coleman and Taylor Intersection

   Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection. This intersection would operate at an unacceptable LOS E (V/C = .912) for PM peak hour condition.

3. S.R. 87 and Taylor Intersection

   It is recommended that this intersection be grade-separated with ramps constructed to permit all turning movements.

4. San Pedro and Julian Intersection

   Due to its downtown location , this intersection is exempted from the City of San Jose's Level of Service Policy. Even so, it is recommended that a signal be installed at this intersection.

5. Market and Julian Intersection

   Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection. This intersection would operate at an unacceptable LOS F (V/C = 1.070) for the PM peak hour conditions.

6. The Alameda and Julian/Hanchett Intersection

   To improve the operation of this intersection during this time period, it is recommended that a barrier median be constructed on Alameda across its intersection with Hanchett. This barrier median extension will result in additional storage capacity for left-turning vehicles. Implementation of this mitigation measure will restrict the movements on Hanchett Avenue to include only right-turns in and out of this intersection. In addition, it is recommended that an island be constructed on the Hanchett leg. This will assist drivers and provide them with a clear indicator of the permitted movements.

7. Stockton and Julian Intersection

In order to improve the operation of this intersection during the most critical time period considered, it would be necessary to reconstruct this intersection to provide the following lane geometrics:

north approach: an exclusive right-turn lane, an exclusive through lane, a shared through and left-turn lane, and an exclusive left-turn lane.

west approach: a shared through and right-turn lane and a shared through and left-turn lane.

Implementation of these mitigation measures would require land acquisition and the widening of the Julian underpass to provide a four-lane cross-section. With these improvements, the projected intersection LOS would improve from LOS F (V/C = 1.336) to LOS D (V/C = .826).

8. Montgomery and Julian Intersection

It is recommended that the west approach of this intersection be widened to provide an additional right-turn lane. This proposed mitigation would require some land acquisition.

The south leg of this intersection would have direct access to the patron parking area for Site A. This roadway segment would need to be modified to accommodate two-directional traffic flow, with some flexibility in terms of lane arrangements during the evenings when arena events are held.

9. S.R. 87 On-Ramp (SB) and Julian Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy due to its downtown location. Even so, it is recommended that the approach (i.e. southbound off-ramp) be widened to provide an additional through lane.

10. S.R. 87 On-Ramp (NB)/Notre Dame and Julian Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy. With the arena traffic included, this intersection is projected to operate at LOS E (V/C = .925). For the two or three times during the year when events start at 6:00 PM the operation of this intersection would remain below acceptable standards.

11. Stockton and Alameda Intersection

It is recommended that this intersection be signalized. If right-of-way permits, Stockton Street should be realigned to improve visibility.

12. Cahill and Alameda Intersection

It is recommended that the south approach of this intersection provide an exclusive right-turn lane, a through lane, and a left-turn lane. The operation of this intersection would remain at LOS E (V/C = .939) for the PM peak hour condition.

13. Montgomery and Alameda Intersection

It is recommended that Autumn operate as a two-directional roadway between Julian and San Fernando. In addition, it is recommended that the east approach of Montgomery and Alameda be restriped to provide an exclusive left-turn lane, a shared left-turn and through lane, and an exclusive through lane. Also, an additional eastbound through lane should be provided through this intersection.

14. Autumn and Santa Clara Intersection

If Autumn operates as a two-directional roadway through this intersection in 1991, it is recommended that the intersection have the following lane geometrics:

north approach: an exclusive right-turn lane, a shared through and left-turn lane.

east approach: an exclusive right-turn lane, a shared through and right-turn lane, an exclusive through lane, and an exclusive left-turn lane.

south approach: a shared through and right-turn lane, an exclusive through lane, and a shared through and left-turn lane.

west approach: an exclusive right-turn lane, a shared through and right-turn lane, an exclusive through lane, and an exclusive left-turn lane.

With these lane configurations, the intersection would operate at LOS F (V/C = 1.00) for the PM peak hour analysis.

15. S.R. 87 Off-Ramp (NB) and Santa Clara Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy due to its downtown location. It should be noted that with the arena traffic, the LOS of this intersection at maximum attendance level is projected to be F (V/C = 1.256). During the two or three days of the year when arena events are held beginning at 6:00 PM, serious operational problems with long queues and delays would occur at this intersection.

16. Santa Teresa and Santa Clara Intersection

This intersection is exempted from the City of San Jose's level of service policy due to its downtown location. Even so, the following mitigation measures are recommended:

westbound: the segment of roadway between Notre Dame and Santa Teresa be restriped to provide an additional westbound through lane.

eastbound: the segment of roadway between the off-ramp and Terraine be restriped to provide an additional eastbound through lane.

Both of these measures would require parking prohibitions.

Implementation of this mitigation measure would improve the operation of the intersection of Santa Teresa and Santa Clara from LOS F (V/C = 1.537) to LOS F (V/C = 1.199).

Due to physical constraints, no additional mitigation measures are possible at this intersection. When the arena events are held beginning at 6:00 PM, serious operational problems with long queues and delays would occur at this intersection.

17. It is assumed that all the signalized intersections would be operating under optimal signal phasing plan for Year 1991 and Year 2000.

For Year 2000

In addition to the mitigation measures already mentioned, the following improvements are recommended for implementation.

1. S.R. 87 and Taylor Intersection

This intersection has already been discussed under Year 1991. However, it should be noted that for Horizon Year 2000, with or without the arena project, major modifications will be required to improve the intersection operation from its projected LOS F (with V/C = 2.1). Therefore, the previously recommended improvement that the intersection be grade-separated with ramps constructed to permit all turning movements would be necessary to accommodate the projected Year 2000 base traffic volumes.

2. River Front and Julian Intersection

This intersection should be designed to have the following lane geometrics:

north approach: an exclusive left-turn lane, a shared left-turn and through lane, and a shared right-turn and through lane.

east approach: an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.

south approach: an exclusive left-turn lane, an exclusive through lane, and a shared through and right-turn lane.

west approach: an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.

With these lane geometrics, the intersection would operate at a LOS E (V/C = .910) for two or three times a year during the PM peak hour.

3. River Front and Santa Clara Intersection

It is recommended that the north approach be widened to provide an additional lane. The lane striping on this approach should be as follows: an exclusive left-turn lane, an exclusive through lane, and a shared through and right-turn lane.

Transit Service Improvements

In addition to the mitigations discussed in the previous section, improvements in transit service to/from the site would also improve the traffic conditions on the streets and at intersections in the site vicinity. Three ways to improve the transit service to/from the arena site include:

1. Provide additional trains (CalTrain Service) for the peak direction of travel immediately before and after the events.

2. Provide an express bus service between Park & Ride Lot locations and the arena site.

3. Run a shuttle bus service between the LRT stations in the downtown area and the arena site.

6.3 Pedestrian

1. After the arena is in operation, the pedestrian flows should be monitored. If warranted, the south side of Santa Clara Street between Almaden and Autumn should be widened from 7 feet to 12 feet.

2. The existing traffic signals along Santa Clara Street between Market Street and Cahill Street will require new signal phasing and timing plans for accommodating future automobile and pedestrian traffic.

3. Handicap ramps should be installed at four intersections.

   Delmas and Santa Clara
   Autumn and Santa Clara
   Montgomery and Santa Clara
   S.R. 87 Off-Ramp (NB) and Santa Clara

4. Street lighting should be improved for the section of Santa Clara Street between Market Street and Stockton Street. The plaza area in front of the arena and the east and north sides of the building should also be well illuminated with floodlights to provide a safe environment for pedestrians.

6.4 Neighborhood Impacts

1. It is recommended that if the residents request a residential permit parking plan, then it should be implemented and strictly enforced to control on-street neighborhood parking.

2. It is also recommended that a neighborhood traffic control program be developed. As part of this program, the residential streets would be monitored after the opening of the arena. If at that time, the arena patrons are found to be utilizing residential streets, measures such as the placement of temporary barricades should be considered during arena operation.

APPENDIX A-2

AIR QUALITY ANALYSIS

ENVIRONMENTAL CONSULTING SERVICES

CUPERTINO, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

Environmental Consulting Services

Noise
Air Quality
Energy

20430H Town Center Lane
Cupertino, CA 95014
(408) 257-1045

AIR QUALITY IMPACT AND MITIGATION STUDY

SAN JOSE SPORTS ARENA PROJECT - SITE A

San Jose, CA

July 17, 1987

Submitted to

DAVID J. POWERS & ASSOCIATES

San Jose, CA

Prepared by

H. STANTON SHELLY

Principal Consultant

AIR QUALITY SECTION

INTRODUCTION

The air quality of a given area is not only dependent upon the amount of air pollutants emitted locally or within the air basin, but also is directly related to the weather patterns of the region. The wind speed and direction, the temperature profile of the atmosphere, and the amount of humidity and sunlight determine the fate of the emitted pollutants each day, and determine the resulting concentrations of air pollutants defining the "air quality."

I. EXISTING SETTING

A. Regional Climate.

The Bay Area climate is a Mediterranean type, characterized by mild and rainy winters, and warm and nearly dry summers. There is a high percentage of sunshine, especially in the summer after the typical morning fog burns off. The temperature, humidity, wind, and precipitation throughout the year depend entirely upon the the movements of marine air, the location and strength of the dominant Pacific high-pressure system, and the coastal temperature gradient.

During the summer the Pacific high typically sits near the California coast, pushing oncoming eastbound storm systems north through the northwest states and Canada. Subsidence of warm air aloft associated with this system creates the frequent summer atmospheric temperature inversion and stagnated conditions. (See the Appendix for definitions of commonly-used meteorological and air quality terms.) The persistent reversal of the normal atmospheric temperature lapse rate (change with temperature) may be several hundred to several thousand feet thick, effectively trapping pollutants emitted at ground level. Winds during the summer are generally light, except for late afternoon onshore flow from differential heating

between the cool ocean and the warm land mass. Average temperatures increase as distance from the Golden Gate increases. Average maximum temperatures during the summer are near 80° F. in the South Bay, and average evening minimums are near 50° F.

During the winter the Pacific high pressure system moves southward, allowing ocean-formed storms to move through the region. With the dominance of the unstable low-pressure systems during the winter, and less sunshine, conditions favoring smog formation are at a minimum. However, radiation cooling during the evening hours sometimes creates thin inversions, concentrating carbon monoxide emissions at ground level. Average maximum winter temperatures in Santa Clara County are about 60° F., and average evening lows are about 40° F.

Lying in the rain shadow of the Santa Cruz Mountains, the South Bay receives only 2/3 of the precipitation which falls upon San Francisco, and a quarter of that falling in the coastal mountains. Very little rain falls in May and October, usually near half an inch, and almost none from June through September. A majority of the rainfall comes in December, January and February, about 3.5 inches per month in normal rainfall years. The annual average rainfall in the South Bay is in the 13 - 15 inch range.

B. Wind Charactistics in the South Bay

Wind in the South Bay is predominantly from the northwest, approximately 30% of the time during the winter, and over 50% during the summer months, as shown in the summary of wind data for downtown San Jose presented in Exhibit 1. The northwest winds are a result of ocean-driven flow coming through the Golden Gate and toward the south bay. During mid-winter months southeasterly winds are present nearly 40% of the time due to freqent low-pressure storm fronts, and their characteristic counter-clockwise flow. Calm conditions occur nearly 13% of the time during the winter, but only 5% during the summer.

EXHIBIT 1 - San Jose Wind Setting

Direction	% of Time	Mean Speed (mph)
Annual Distribution		
NE	3.1	1.5
E	0.5	1.4
SE	16.9	2.7
S	19.2	4.2
SW	6.8	2.2
W	1.1	2.5
NW	40.7	4.3
N	2.9	2.4
Calm	8.9	---
	100	3.3
Winter Distribution		
NE	2.9	1.5
E	0.5	1.4
SE	20.8	2.6
S	23.5	4.4
SW	7.9	1.9
W	1.5	2.4
NW	28.1	3.9
N	2.1	2.6
Calm	12.7	---
	100	3.0
Summer Distribution		
NE	3.0	1.5
E	0.4	1.5
SE	11.4	3.0
S	17.4	4.3
SW	5.4	2.6
W	0.6	2.9
NW	52.8	4.6
N	3.9	2.4
Calm	5.1	---
	100	3.8

Average wind speeds in the downtown San Jose project area are less than 5 mph on an annual average basis. The highest wind speeds occur during late afternoon on-shore cooling in the summer, and during winter storms. During storm periods winds frequently gust at 20 to 30 mph.

C. Ambient Air Quality

Air quality near the project area in downton San Jose is subject to the problems experienced by most of the Bay Area, and particularly the south portion. Emissions from millions of vehicle-miles of travel each day often are not mixed and diluted, but are trapped near ground level by a temperature inversion. Prevailing air currents generally sweep from the mouth of the Bay toward the south, picking up and concentrating pollutants in the basin around San Jose and the Almaden Valley. A combination of emissions in the South Bay, the transport of pollutants from other areas, and the natural mountain barriers (the Diablo Range to the east and the Santa Cruz Range to the southwest) produce high concentrations, which sometimes exceed ambient air quality limits established by the Bay Area Air Quality Management District (BAAQMD). The most recent air quality data from the nearest BAAQMD monitoring station on 4th Street in San Jose, and the ambient standards presently in effect, are tabulated in Exhibit 2.

Ozone, the primary oxidant "smog" component, is produced by complex reactions of hydrocarbons and NO_x in the atmosphere. Daily ozone concentrations are heavily dependent upon the weather, and thus vary substantially from year to year. Since the adverse atmospheric conditions in 1978, when 12 exceedances were recorded in San Jose, high oxidant days had been significantly lower. However, 1983 and 1984 were unusually warm and stratified ozone seasons, with 9 and 7 exceedances, respectively. The 1985 and 1986 summer weather was cooler and had a more normal ventilation pattern, bringing ozone exceedances back down. The 3-year Expected Annual Exceedance value (average of last three years) is now 3.3.

EXHIBIT 2

AMBIENT AIR QUALITY

Downtown San Jose

POLLUTANT	1984	1985	1986	Std	Meas. Units
OZONE					
Maximum	16	14	14	12 (1)	pphm, 1-hr ave
Exceedances	7	2	1	1	days per year
3-year average	5.3	6.0	3.3	1	Expected Annual Exceedances
CARBON MONOXIDE					
Maximum 8-hour	20	21	11	9 (2)	ppm, 8-hr ave
8-hour exceedances	5	17	4	1	days per year
NITROGEN DIOXIDE					
Maximum	18	19	16	25 (3)	pphm 1-hr ave
Exceedances	0	0	0	1	days per year
TOTAL SUSPENDED PARTICULATES					
Annual mean	79	90	(6)	60 (4)	annual geometric mean
Daily exceedances	6	19	24	1 (5)	% of days above 150 ug/m^3

NOTES:

(1) Federal standard; State standard is 10 pphm.
(2) Federal and State ambient standard; State standard is also 20 pphm for 1 hour.
(3) State standard; Federal standard is 5 pphm annual average.
(4) State standard; Federal standard is 75 ug/m^3
(5) Federal standard; State standard is 100 ug/m^3, measured as thoracic particles (small diameter).
(6) Not published for 1986

Source: BAAQMD monitoring data -- 4th Street station, S.J.

Another problem pollutant in the South Bay, carbon monoxide, like oxidant, is also heavily dependent upon both vehicle emissions and weather. High CO concentrations in the South Bay occur mostly during winter evenings with little wind. Exceedances of the 9 ppm 8-hour ambient standard increased to 17 during 1985 in San Jose, the highest number of exceedances since 1979, but dropped again in 1986, to 4 incidents. Both CO and oxidant have been reduced significantly by improved emission controls on new automobiles in the past decade.

Total suspended particulates, produced by vehicles, heavy industry, and soil-moving activities, dropped impressively in 1983, but heavy construction in downtown San Jose have produced high concentrations since 1984. The ambient standard of 100 ug/m^3 for 24-hour sampling has been exceeded a significant number of the days tested in downtown San Jose for the past three years. These readings are not considered representative of the general San Jose exposure, but they are probably fairly representative of the nearby project area.

Sulfur dioxide is primarily associated with chemical and refining industries, and has never approached the ambient standard in the San Jose area, nor have SO_2 standards been exceeded anywhere in the District since 1976, and are not reported now in the South Bay.

Nitrogen oxides are produced heavily by vehicles and high-temperature industrial operations, but as yet have not posed serious problems in the region. The South Bay often has the highest NO_x concentrations in the District, however.

Because there are exceedances of some ambient standards in the Bay Area, the District has been designated a Non-Attainment Area by the Environmental Protection Agency for CO, ozone, and TSP. All significant sources in the District must share responsibility for basin exceedances, including those sources in locations where air quality is good.

II. POTENTIAL AIR QUALITY IMPACTS OF PROJECT

The scope of the San Jose Sports Arena project is the siting and construction of a new City Sports Arena in one of three locations in the San Jose metropolitan area. This study evaluates potential air quality impacts associated with the "Site A" alternative at West Santa Clara and Montgomery Streets. Option 1 includes surface lot parking adjacent to the site, while Option 2 has some surface lot parking adjacent and an additional 3-4 level parking garage for approximately 800 vehicles.

Vehicle trips carrying patrons to and from events at the Sports Arena are the primary sources of emissions associated with the implementation of the project. The trip profile associated with the Sports Arena is an incoming group of vehicles (approximately one vehicle per 3 patrons) in the 90 minutes or so prior to event starting time, and the reverse trip pattern in the 60 minutes following the event. This profile is essentially superimposed upon the existing commute-based traffic pattern. The peak arrival traffic for a normal weekday evening event is expected to follow the afternoon peak commute period closely, but not coincide with it.

Other types of air quality impacts associated with this project, such as stationary sources of pollutants, include heating system emissions, which represent a minimal contribution. Potential dust and particulates generated during site preparation and grading may be controlled by routine application of water and/or road oil.

Particulates generated by roadway resuspension are relatively small amounts very near the roadway. Although it is possible to estimate a range of values for these contributions, the estimates would have little validity except under specific and controlled conditions not found in actual practice.

A. Sensitive Receptor Locations

Sensitive receptors for potential air quality impacts of the San Jose Sports Arena project are primarily the older residential neighborhoods to the northeast of Julian/Guadelupe and southwest of Stockton Avenue. A few scattered

residential locations in the area north of the site also remain. Representative worst-case receptor locations have been selected at (1) Fox Avenue and San Pedro, another at (2) Rhodes and W. Julian, and (3) at Montgomery and W. Julian (refer to the Project Map, Appendix Page A-3). The extent to which these locations would be affected by the proposed project is evaluated in the following sections. Other receptor locations in the project area would experience similar or lesser impacts.

B. Data and Methodology

Vehicles are responsible for emission of a number of pollutants -- carbon monoxide (CO), hydrocarbons, particulates, NOx, and others. The most widely-used method of evaluating the potential impact of project vehicular emissions is modeling the concentration of CO at nearby sensitive receptor locations.

Vehicular carbon monoxide emissions are directly related to the number of vehicle trips, and to the average vehicle emission rate. Newer vehicles have lower emission rates than older vehicles because of better emission controls. In addition, average emissions per mile decrease as average speed increases. But after the pollutants are emitted, atmospheric conditions control pollutant mixing, dispersion, and the ultimate concentrations achieved. These interrelated factors are considered in a simplified way by roadside CO dispersion modeling.

The CALINE 3 multiple line-source model used for this study was developed by the California Department of Transportation (Ref. 5), based upon standard Gaussian diffusion relationships developed by Turner (Ref. 6) and others. In basic terms, CALINE takes emissions from major arterials in the area, under stagnated atmospheric conditions and low wind speed, and sums the contributions of major roadways at selected receptors for various wind directions.

To evaluate the potential air quality impacts, six traffic conditions are evaluated and compared, based upon the traffic study for the project by Barton-Aschman Associates, Inc, San Jose (July 1987):

1. Existing 1987 traffic

2. Base case 1991 traffic

3. Year 1991 traffic, 17,500-patron event

4. Year 1991 traffic, 20,000-patron event

5. Year 2000 traffic, 17,500-patron event

6. Year 2000 traffic, 20,000-patron event

A list of specific streets included in the analysis is given in Exhibit 3.

CALINE modeling parameters, and input geometric and traffic parameters used are described on Appendix Page A-4. Sample modeling summary sheets for three traffic conditions are on the following pages in the Appendix, which give parameter values as well as the resulting CO concentrations in parts per million (ppm) for each receptor. Composite vehicle emission factors are taken from the California Air Resources Board EMFAC 6 program (Ref. 7).

Exhibit 3
Streets Modeled with CALINE

Coleman Avenue	Market Street
Guadelupe Expressway	Julian Street
W. Santa Clara Street	The Alameda
Montgomery Street	Autumn Street
Stockton Avenue	Naglee Street

Note: Some streets are modeled with 2 or 3 links

C. Impact Analyses

Carbon monoxide concentrations at the three receptors have been modeled during peak hour for each traffic condition and for eight wind conditions. Emissions are accumulated by CALINE from each of 20 street segments ("links")

in the project area defined by the streets listed in Exhibit 3. CO concentrations for the wind directions giving the highest values are tabulated in Exhibit 4 below for the six cases.

Exhibit 4

PEAK HOUR CARBON MONOXIDE MODELING (ppm)

CASE	RECEPTOR 1	2	3
1. Existing - 1987	1.3	0.4	0.8
2. Base case - 1991	0.6	0.5	1.1
3. Year 1991 - 17,500	0.6	0.5	1.2
4. Year 1991 - 20,000	0.6	0.5	1.2
5. Year 2000 - 17,500	0.5	0.7	0.8
6. Year 2000 - 20,000	0.5	0.7	0.8

Local Background Concentration : 12 ppm
Ambient Standard : 20 ppm

Exhibit 4 shows that traffic associated with the Sports Arena will not increase air quality concentrations at residential receptors in the vicinity in any significant way. This is because project traffic volumes will be distributed on a number of access streets in the area, while average emissions per vehicle continue to be reduced, as newer vehicles with superior emission controls replace older vehicles. In addition, the completion of the Guadelupe Freeway connection in the area is expected to divert some local street traffic and relieve associated congestion, which will reduce emissions and CO concentrations near local arterials, particularly near Receptor 1.

Background concentrations are the combined result of vehicular emissions from all streets in an area; the values listed are taken from Pages V-10 and V-11 of the BAAQMD Assessment Guidelines (Ref. 8). The total CO concentrations under stagnated atmospheric conditions are the sum of local background plus the modeled concentrations, which would not appear to cause the State ambient standards to be exceeded, with or without the project.

However, some simplifications are made by the modeling procedure, one of which is to assume a constant lower-speed traffic flow during peak hour conditions, rather than stop-and-go cycles. At some congested intersections, emissions could be higher than modeled. In addition, under severe atmospheric stagnation which occurs a few times each year (near-zero wind speeds and a very low atmospheric inversion, which cannot be modeled in a straightforward fashion), ambient standards could be exceeded. To the extent that Sports Arena events coincide with these stagnation periods, the project would contribute to increased local CO concentrations at a time when ambient standards are exceeded throughout the south bay region.

D. Total Project Emissions

Another way of assessing potential air quality impacts is to estimate the total daily project-related vehicular emissions. The Sports Arena will not have a consistant "daily" contribution, but an event could occur a few times per week. Total emissions are computed by considering the emissions associated with the 6,500 project trips with an average trip length of 20 miles (per Ref. 8, Table VI-B-1). Exhibit 5 is a comparison of total emissions for the four pollutants of concern.

Exhibit 5

Emissions Comparisons (1995 - Tons per day)

	CO	NMHC	NOx	PART
Project	0.18	.015	.019	.004
BAAQM District				
Vehicle	1430	142	183	351
Total	2160	532	486	708
Santa Clara County				
Vehicle	24%	12%	14%	12%
Total	26%	24%	18%	23%

Emissions are converted to tons per day to relate them to the estimated total District vehicular emissions in the year 1995. Santa Clara County emissions, as a percent of District emissions, also are tabulated for comparison. All non-project emission estimates are from Reference 9.

E. Relationship Of Project To District Air Quality Plan (AQP)

The 1982 Bay Area Air Quality Plan (Ref. 9) presents the policies and methods adopted for meeting the mandated National Ambient Air Quality Standards in the Bay Area. The recommended policies in the AQP which would be most relevent to reviewing agencies and individual projects are designated "Transportation Control Measures (TCMs)," acknowledging the primary role vehicles play in air quality control problems and their solution.

F. Parking-Related Air Quality Impacts

In addition to the emissions generated by the Sports Arena patrons driving to and from the site, short-term emissions incidents would be produced while the vehicles are entering and leaving the parking lot or garage, particularly while leaving. After an event, patrons leave essentially at the same time, with many vehicles idling while in queue to exit a parking lot or garage. This section discusses concentrations adjacent to a Sports Arena parking lot and inside a parking garage following an event.

Parking Lot Idling Emissions

The receptor CO concentrations downwind from a area source such as a parking lot are given in the following relationship from Reference 10:

$$C = \frac{0.8\,Q\,(\,x2^{(1-b)} - x1^{(1-b)}\,)}{A\,U\,a\,(1-b)\,R}$$

where

- x1 = the distance to the near boundary of lot (meters)
- x2 = the distance to the far boundary of lot (meters)
- A = area of parking lot (meters^2)
- U = wind speed (meters/sec)
- a,b = atmospheric dispersion parameters
- Q = emission rate of lot (mg/sec)
- R = conversion factor from mg/m^3 to ppm
- C = concentration of CO (ppm)

Using this model to estimate concentrations across the street (100 feet) from the proposed 400-car parking lot at Julian and Montgomery, assuming poor atmospheric conditions, 1 meter per second wind speed, a full lot of vehicles idling at once, the receptor concentration of CO would be 12 ppm.

CO Concentrations Inside a Parking Garage

Idling motor vehicles within enclosed areas produce the most serious human exposures to carbon monoxide. Examples include heavily-traveled tunnels and relatively closed parking garages. Even so, if traffic is evenly distributed, so that only a few autos are operating at the same time, high concentrations do not build up. Parking garages dedicated to scheduled events such as the proposed Sports Arena, as opposed to more evenly distributed retail or commercial use, are the most severe parking garage exposures.

For the proposed 3-level, 800-vehicle parking garage in the Site A/Option 2, the following assumptions have been used:

Size of interior garage level : 200' x 400' x 10'
Vehicles per level : 270
Vehicle time spent idling in garage : 15 minutes
Air flow : 10 meters per minute

The modeling relationship, adapted from Reference 10, is as follows :

$$C = \frac{Qa \times T}{H \times R}$$

where the parameters different than in the previous parking lot computation are :

Qa = emission rate (mg/min*m^2)
T = time for wind to cross garage = D/U (min)
D = distance across garage (m)
H = interior height of garage level (m)

For the assumptions and parameters above, an interior locations at the "downwind" side of the garage would experience a CO concentration of 300 ppm, while the upwind side of the garage would experience basically ambient concentrations. For faster air flow through the garage, fewer vehicles operating at once, or shorter periods of idling (vehicles leaving garage more quickly), the concentration would be proportionately lower.

The recommended maximum one hour exposure to CO is 20 ppm, to prevent elevated carbon monoxide levels in the blood, which can cause temporary deficiencies in the ability to do physical and mental tasks, and may cause headaches. Although this type of exposure is not unique to the parking garage for this project, and cigarette smokers typically inhale 400-500 ppm concentrations of CO, the exposure should not be taken lightly even for an infrequent exposure.

Open-architecture garage design promoting both natural convection and wind-driven ventilation would be a minimum recommendation. In addition, patrons should use caution and closed windows in extended garage idling situations.

III. AIR QUALITY MITIGATION MEASURES

Mitigation thresholds for potential air quality impacts are described and classified by type of project in the BAAQMD Assessment Guidelines (Ref 8). From Table IX-B-3, the San Jose Arena project is below the Category C mitigation threshold for planning actions affecting any facility generating more than 5,000 vehicles.

Measures relevant to the Sports Arena, taken from the full range of potential air quality mitigation measures described in detail in Section IX of the new BAAQMD Guidelines, are summarized in the following paragraphs. The recommended mitigations should be given serious consideration for implementation by the City of San Jose planning and development review agencies. The recommended transportation-related mitigations should be considered by both City and Santa Clara County transportation planning agencies.

A. PHYSICAL FACILITIES to support improvements in transit and flow of traffic.

1. Bicycle and Pedestrian Facility Improvements. Includes pedestrian pathways, safe bicycle routes and secure bicycle storage facilities.

2. Transit Improvements and Amenities. Additional transit stops, bus turnouts and shelters, passenger amenities, and special bus and carpool lanes.

3. Street And Traffic Flow Improvements. Traffic engineering changes which improve traffic flow, such as more lanes, turning lanes, and demand signalization of intersections, can make significant improvements; an average vehicle speed increase of 5 mph can achieve a 20% reduction in CO and hydrocarbon emissions.

4. Site Plan Changes for better traffic flow.

B. TRANSPORTATION-RELATED MANAGEMENT ACTIONS to encourage single-occupant patrons to switch to either public transit or multiple- passenger vehicles.

1. Transit Incentives and Agreements to improve project/transit interactions, such as improved routes and schedules to serve the project.

In practice, the effectiveness of any mitigation measure is directly proportional to reductions in traffic flow congestion and to the number of drivers that are willing to give up single-occupant travel. Actual reductions in emissions vary between 1 to 15% depending upon the measure. Clearly, the effectiveness of transportation alternatives is improved as the alternatives are made more attractive to drivers relative to travel in single-occupant vehicles. More detailed coverage of vehicular emission mitigation measures and associated benefits are presented in Section IX of Reference 10.

IV. UNAVOIDABLE AIR QUALITY IMPACTS WHICH CANNOT BE FULLY MITIGATED

1. Significant increases in CO concentrations near congested intersections during arrival and departure of Sports Arena patrons under poor atmospheric conditions.

2. High exposures to CO inside Sports Arena parking garage during event arrival and departure periods.

AIR QUALITY REFERENCES

BAY AREA CLIMATOLOGY

1. Felton, E.L., California's Many Climates, Pacific Books, Palo Alto, 1965.

2. Gilliam, H., Weather of the San Francisco Bay Region, University of California Press, Berkeley, 1962.

AIR QUALITY

3. "Contaminant and Weather Summary", monthly station monitoring data, Bay Area Air Quality Management District, San Francisco.

4. Annual summaries of station air quality data, BAAQMD, San Francisco.

MODELING

5. Benson, Paul, CALINE 3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, Report No. FHWA/CA/TL - 79/23, California Dept. of Transportation, Sacramento, Nov 1979. IBM-based computer program by California Air Resources Board.

6. Turner, D. Bruce, Workbook of Atmospheric Dispersion Estimates, AP-26, U.S. Environmental Protection Agency, 1970.

7. "ENV028" computer program to determine annual composite vehicle emission rates, based upon "EMFAC 6D" vehicle-specific emission rate program, California Air Resources Board, Sacramento.

8. Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans, Planning Division, Bay Area Air Quality Management District, San Francisco, November 1985.

9. 1982 Bay Area Air Quality Plan, Association of Bay Area Governments (with Metropolitan Transportation Commission and BAAQMD), Berkeley, Dec 1982.

10. Guidelines for AQ Maintenance Planning and Analysis, Volume 9 (Revised): Evaluating Indirect Sources, Report EPA-450/4-78-001, U.S. Environmental Protection Agency, Research Triangle Park, NC, Sept 1978.

APPENDIX

COMMON AIR QUALITY TERMS AND DEFINITIONS

Air basin or airshed - a region which, due to its geography and topography, tends to contain air pollutants emitted within it.

Air pollutant - a substance in the atmosphere which is harmful or undesirable.

Air quality - the amount of pollutants in the air relative to existing ambient air quality standards*.

Air Resources Board (ARB) - California agency responsible for state air quality planning and control program.

Ambient Air Quality Standards - exposure limits established for various air pollutants by state and federal agencies.

Bay Area Air Quality Management District (BAAQMD) - nine-county agency responsible for air quality planning and control in the San Francisco Bay area.

Carbon monoxide (CO) - an odorless and invisible gas pollutant produced primarily by vehicle operation. Reduces oxygen-carrying capacity of the blood, causing headache, fatigue, coordination disfunction, and cardio-respiratory stress.

Concentration - the amount of a pollutant in a given volume or sample of air.

Department of Environmental Protection (NDEP) - Nevada agency responsible for state air quality planning and control programs.

Dispersion - the process of mixing, dilution, and transport of air pollutants.

Emission - discharge of a substance into the air.

Environmental Protection Agency (EPA) - federal agency with overall responsibility for national and state air quality planning and control programs.

Hydrocarbons (HC) - a large group of compounds containing hydrogen, carbon and various other elements, and found in fossil fuels, paints and solvents. They cause plant damage, odor, and contribute to smog* formation.

Inversion - a reversal of the normal temperature lapse rate* in the atmosphere, producing a stable high-temperature layer above a lower-temperature layer.

Line source - a linear group of pollutant emitters, such as vehicles on a roadway.

Micrograms per cubic meter ($\mu g/m^3$) - a common unit of measurement of particulate concentration* in weight per unit volume.

Mixing layer - when an atmospheric temperature inversion* exists, the layer of air below the inversion altitude in which air pollutants are confined.

Modeling - a technique of using estimated source emissions and meteorological information to compute expected air pollutant concentrations.

Monitoring - regular measurement of air pollutant concentrations.

Nitrogen oxides (NO_x)- formed during high-temperature combustion processes, several gaseous pollutants cause plant damage, eye and lung irritation, and discoloration of materials. Nitrogen dioxide causes the typical brown color of smog.*

Odor - can be aesthetically unpleasant, and cause illness in some cases. Common problem gases include hydrogen sulfide, ammonia, and some organic vapors.

*defined elsewhere

Organic compounds - a very large group of substances containing carbon,found in all living matter, and also fossil material such as coal and petroleum. They are often released when extracted, processed, and/or burned.

Oxidants - a highly-active group of chemicals (mostly ozone in air) formed in the atmosphere by the photochemical reaction* of hydrocarbons*, nitrogen oxides*, and sunlight. Causes extensive vegetation damage, eye irritation, headache, and impaired breathing.

Ozone (O_3) - see Oxidants above.

Particulates, total suspended (TSP) - include solid particles, dust, and smoke, and are produced by industrial processes, combustion, and vehicles. They damage plants and materials, reduce sunlight and visibility, and carry irritating chemicals into the respiratory system.

Parts per million (ppm) - a common unit of measurement of gaseous pollutant concentration in relative volume of pollutant per million volumes of air.

Photochemical reaction - the atmospheric combination of hydrocarbons* and oxides of nitrogen to form oxidants* and smog*, driven by the energy from intense sunlight.

Point source - a single stationary souce of air pollution.

Primary air quality standards - recommended limits to air pollutant concentrations based upon criteria for protection of human health.

Secondary air quality standards - recommended limits to air pollutant concentrations based upon criteria for protection of property and aesthetics.

Smog - the combination of air pollutants found during intense photochemical reaction.*

Source - a process, activity, or machine which emits air pollution.

Stagnation - an extremely stable atmospheric condition in which little vertical or horizontal dispersion* of emitted pollutants occurs.

Sulfur oxides - are produced by processing and combustion of fossil fuels which have sulfur content. These gaseous pollutants are toxic to plants, deteriorate materials, and in combination with particulates, contribute to serious respiratory illness.

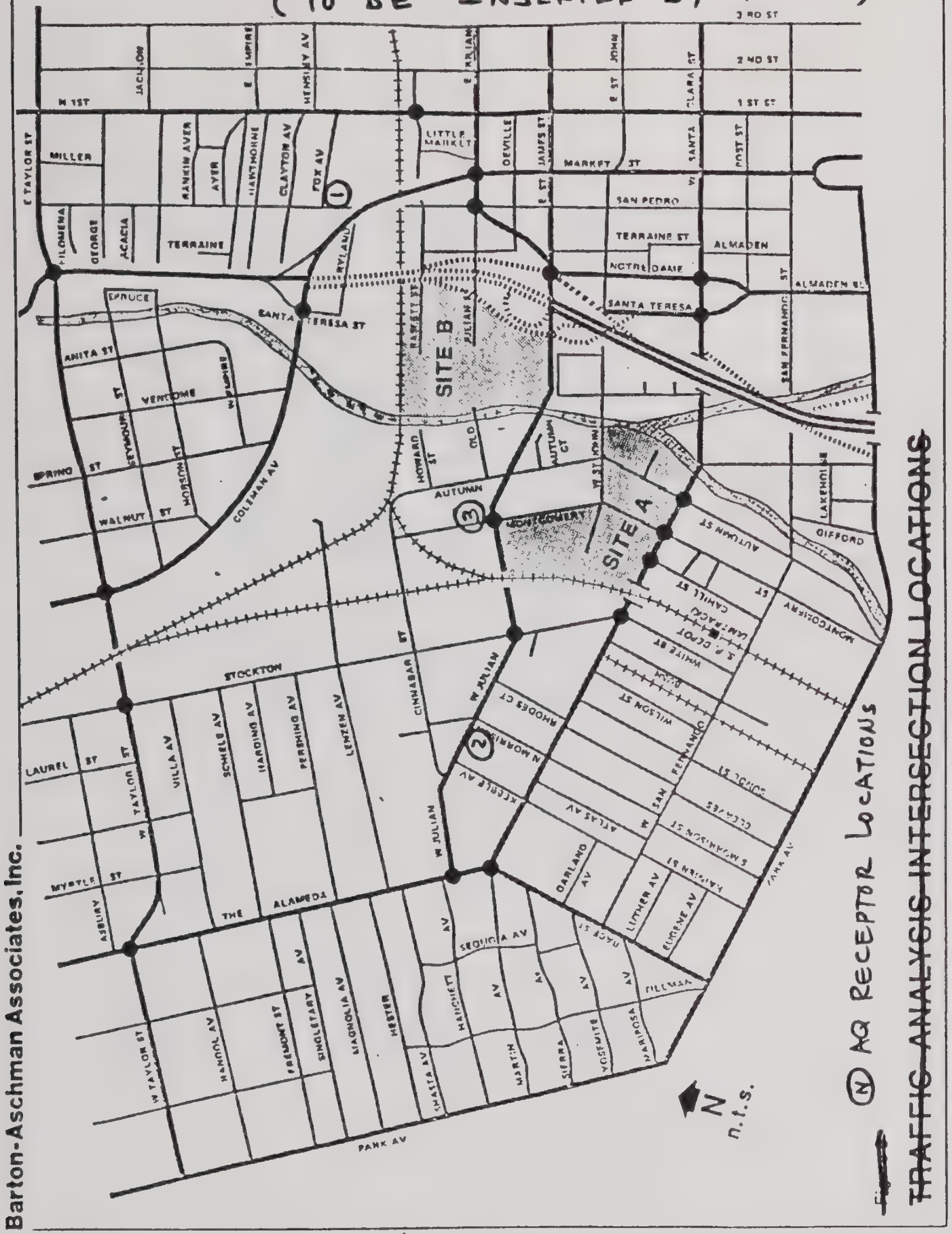
Temperature lapse rate - the normal atmospheric temperature profile which decreases as altitude increases. See Inversion*.

Transport - the movement of emitted pollutants by wind or thermal action.

Visibility reduction - is caused by suspended very small particles, water vapor, smoke, and gases with color.

*defined elsewhere

Appendix DRAFT
(TO BE INSERTED BY D.P.A.)



CALINE 3 VARIABLE DESCRIPTIONS

SITE VARIABLES

Run	title of modeling run
U	wind speed (m/sec)
MIXH	atmospheric mixing height (m)
ZO	measure of roughness of surface topography (cm)
BRG	wind direction (degrees)
ATIM	averaging time (min)
VS	settling velocity (cm/sec)
CLASS	atmospheric stability class 1 = least stable, 6 = most stable
AMB	ambient concentration (set to zero to highlight project contributions)
VD	deposition velocity (cm/sec)

LINK VARIABLES

1,2,...	link (street segment) number
X,Y	link end coordinates
TYPE	link type: AG= at grade, FL= fill, BR= bridge, DP= depressed
VPH	traffic volume (vehicles/hour)
EF	composite emission factor (gms/mi)
H	link height (m)
W	street width (m)

RECEPTOR COORDINATES

1,2,3...	receptor number
X,Y,Z	receptor coordinates, elevation

MODEL RESULTS

CO/LINK	CO contributions by link
TOTAL	total concentration at receptor

CALINE3

RUN :(1) SAN JOSE ARENA SITE A

1.0 SITE VARIABLES

```
     U=  2  M/S     BRG=  90  DEGREES   CLASS=  6
  MIXH=  1000  M ATIM=  60  MINUTES     AMB=  0   PPM
    ZO=  100  CM     VS=  0  CM/S        VD=  0   CM/S
```

2.0 LINK VARIABLES

LINK	LINK COORDINATES (M) X1	Y1	X2	Y2
1	48	2977	569	2797
2	569	2797	1078	3097
3	1078	3097	1420	2696
4	1420	2696	2037	1683
5	431	3582	952	2941
6	952	2941	1222	2378
7	1222	2378	1689	916
8	-240	1989	485	2025
9	485	2025	707	2198
10	707	2198	1294	2402
11	1294	2402	1420	2696
12	1078	1833	2132	2444
13	-1120	2935	-54	1785
14	-54	1785	1078	1833
15	539	2402	881	2007
16	881	2007	940	1282
17	1462	2043	1767	1539
18	970	2055	940	1282
19	-347	3013	665	1815
20	-990	2192	1569	4043

CALINE3

RUN :(1) SAN JOSE ARENA SITE A

LINK	LINK DESCRIPTORS TYPE	VPH	EF	H	W
1	AG	1500	18.1	0	20.7
2	AG	2740	18.1	0	20.7
3	BR	2800	18.1	5	20.7
4	AG	2400	18.1	0	20.7
5	AG	2500	14.3	0	24
6	BR	0	0	9	24
7	BR	2530	14.3	7	27.6
8	AG	540	21.3	0	13.4
9	AG	1170	21.3	0	13.4
10	AG	1900	18.1	0	13.4
11	AG	2400	18.1	0	13.4
12	AG	1900	18.1	0	20.7
13	AG	2660	18.1	0	20.7
14	AG	1930	18.1	0	20.7
15	AG	280	21.3	0	17
16	AG	430	21.3	0	17
17	AG	2230	21.3	0	24
18	AG	1000	21.3	0	17
19	AG	940	19	0	18.2
20	AG	1590	18.1	0	20.7

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	X	Y	Z
1	1192	2983	1.3
2	270	2025	1.3
3	719	2228	1.3

4.0 MODEL RESULTS

RECEPTOR	CO/LINK 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL PPM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	.3	0	0	0	.1	0	0	0	0	0	0	0	0	.4
3	0	0	0	0	0	0	0	0	0	.7	0	.1	0	0	0	0	0	0	0	0	.8

CALINE3

RUN :(4) SAN JOSE ARENA SITE A

1.0 SITE VARIABLES

U= 2 M/S BRG= 225 DEGREES CLASS= 6
MIXH= 1000 M ATIM= 60 MINUTES AMB= 0 PPM
Z0= 100 CM VS= 0 CM/S VD= 0 CM/S

2.0 LINK VARIABLES

LINK COORDINATES (M)

LINK	X1	Y1	X2	Y2
1	48	2977	569	2797
2	569	2797	1078	3097
3	1078	3097	1420	2696
4	1420	2696	2037	1683
5	431	3582	952	2941
6	952	2941	1222	2378
7	1222	2378	1689	916
8	-240	1989	485	2025
9	485	2025	707	2198
10	707	2198	1294	2402
11	1294	2402	1420	2696
12	1078	1833	2132	2444
13	-1120	2935	-54	1785
14	-54	1785	1078	1833
15	539	2402	881	2007
16	881	2007	940	1282
17	1462	2043	1767	1539
18	970	2055	940	1282
19	-347	3013	665	1815
20	-990	2192	1569	4043

CALINE3

RUN :(4) SAN JOSE ARENA SITE A

LINK DESCRIPTORS

LINK	TYPE	VPH	EF	H	W
1	AG	1620	17	0	20.7
2	AG	1460	17	0	20.7
3	BR	1500	17	5	20.7
4	AG	2200	17	0	20.7
5	AG	2950	12.3	0	24
6	BR	2500	12.3	9	24
7	BR	2550	12.3	7	27.6
8	AG	790	19.4	0	13.4
9	AG	1700	19.4	0	13.4
10	AG	2670	16.5	0	13.4
11	AG	2500	16.5	0	13.4
12	AG	2140	16.5	0	20.7
13	AG	2930	16.5	0	20.7
14	AG	2110	16.5	0	20.7
15	AG	670	19.4	0	17
16	AG	620	19.4	0	17
17	AG	1880	19.4	0	24
18	AG	970	19.4	0	17
19	AG	1050	17	0	18.2
20	AG	1780	16.5	0	20.7

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	X	Y	Z
1	1192	2983	1.3
2	270	2025	1.3
3	719	2228	1.3

4.0 MODEL RESULTS

CO/LINK (PPM)

RECEPTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL PPM
1	0	0	.1	0	0	.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.2
2	0	0	0	0	0	0	0	.3	0	0	0	0	0	.1	0	0	0	0	0	0	.4
3	0	0	0	0	0	0	0	0	1	0	0	0	0	.1	.1	0	0	0	0	0	1.2

CALINE3

RUN : (6) SAN JOSE ARENA SITE A

1.0 SITE VARIABLES

U= 2 M/S BRG= 90 DEGREES CLASS= 6
MIXH= 1000 M ATIM= 60 MINUTES AMB= 0 PPM
Z0= 200 CM VS= 0 CM/S VD= 0 CM/S

2.0 LINK VARIABLES

LINK	X1	Y1	X2	Y2
1	48	2977	569	2797
2	569	2797	1078	3097
3	1078	3097	1420	2696
4	1420	2696	2037	1683
5	431	3582	952	2941
6	952	2941	1222	2378
7	1222	2378	1689	916
8	-240	1989	485	2025
9	485	2025	707	2198
10	707	2198	1294	2402
11	1294	2402	1420	2696
12	1078	1833	2132	2444
13	-1120	2935	-54	1785
14	-54	1785	1078	1833
15	539	2402	881	2007
16	881	2007	940	1282
17	719	2027	970	2055
18	970	2055	940	1282
19	-347	3013	665	1815
20	-990	2192	1569	4043

LINK COORDINATES (M)

CALINE3

RUN : (6) SAN JOSE ARENA SITE A

LINK DESCRIPTORS

LINK	TYPE	VPH	EF	H	W
1	AG	2100	13.9	0	20.7
2	AG	1550	13.9	0	20.7
3	BR	1530	13.9	5	20.7
4	AG	1450	13.9	0	20.7
5	AG	6020	10.3	0	24
6	BR	6060	10.3	9	24
7	DR	6080	10.3	7	27.6
8	AG	1150	16.3	0	13.4
9	AG	1030	16.3	0	13.4
10	AG	2190	13.9	0	13.4
11	AG	2700	13.9	0	13.4
12	AG	2930	13.9	0	20.7
13	AG	2300	13.9	0	20.7
14	AG	1640	13.9	0	20.7
15	AG	800	16.3	0	17
16	AG	750	16.3	0	17
17	AG	900	14.1	0	21.5
18	AG	1050	16.3	0	17
19	AG	410	14.5	0	18.2
20	AG	2080	13.9	0	20.7

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	X	Y	Z
1	1192	2983	1.3
2	270	2025	1.3
3	719	2228	1.3

4.0 MODEL RESULTS

CO/LINK

RECEPTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL PPM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	.1	.5	0	0	0	.1	0	0	0	0	0	0	0	0	.7
3	0	0	0	0	0	0	.1	0	0	.6	0	.1	0	0	0	0	0	0	0	0	.8

APPENDIX A-3

ACOUSTICAL ANALYSIS

EDWARD L. PACK ASSOCIATES, INCORPORATED

SANTA CLARA, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

EDWARD L. PACK ASSOCIATES, INC.

Consulting Engineers

TELEPHONE (408) 727-6840

2940 SCOTT BOULEVARD
SANTA CLARA, CALIF 95054

July 24, 1987
Project No. 19-047

Mr. David Powers
David J. Powers Associates
1885 The Alameda, Suite 210
San Jose, CA 95126

Subject: Roadway, Railroad, and Aircraft Noise Assessment Study for the Proposed Arena, Site "A", Downtown San Jose

Dear Mr. Powers:

This report presents the results of a noise assessment study for a proposed arena on Site A in downtown San Jose, as shown on the Site Plan, Ref. (a), and on Figures 1 and 2. This assessment includes a description of the existing acoustical environment, results of noise measurements, noise impacts that would result from the proposed project, a discussion of the applicable noise standards, and mitigation measures required to achieve compliance with the standards. Appendices A and B, attached, include the list of references, discussion of applicable standards, terminology and a description of the instrumentation used for the field survey.

I. Acoustical Setting

A. Description of the Study Area

The arena site currently called Site A, is located in the downtown area of the City of San Jose, and is bounded by the Southern Pacific Railroad to the west, Julian and St. John

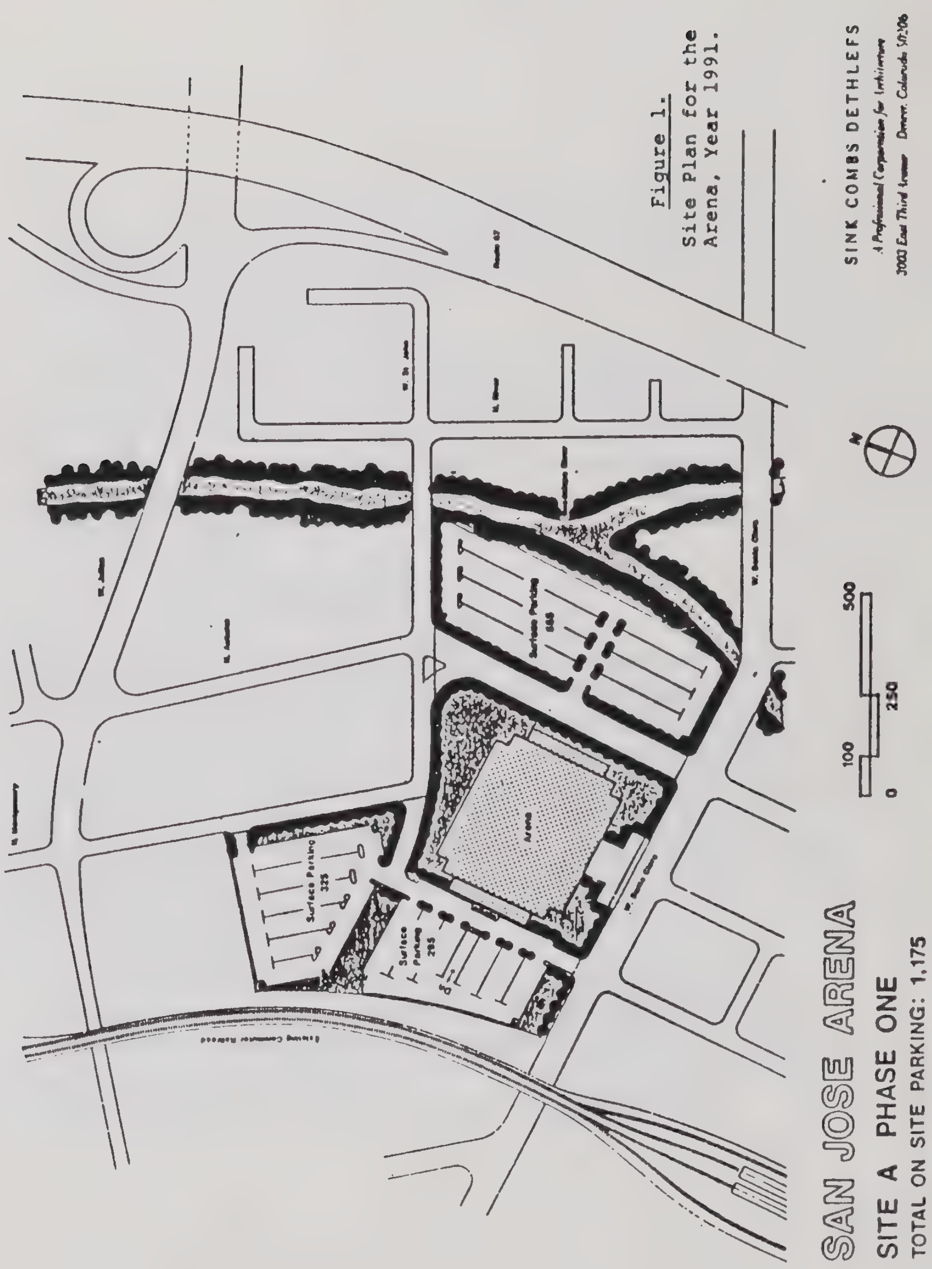


Figure 1.
Site Plan for the Arena, Year 1991.

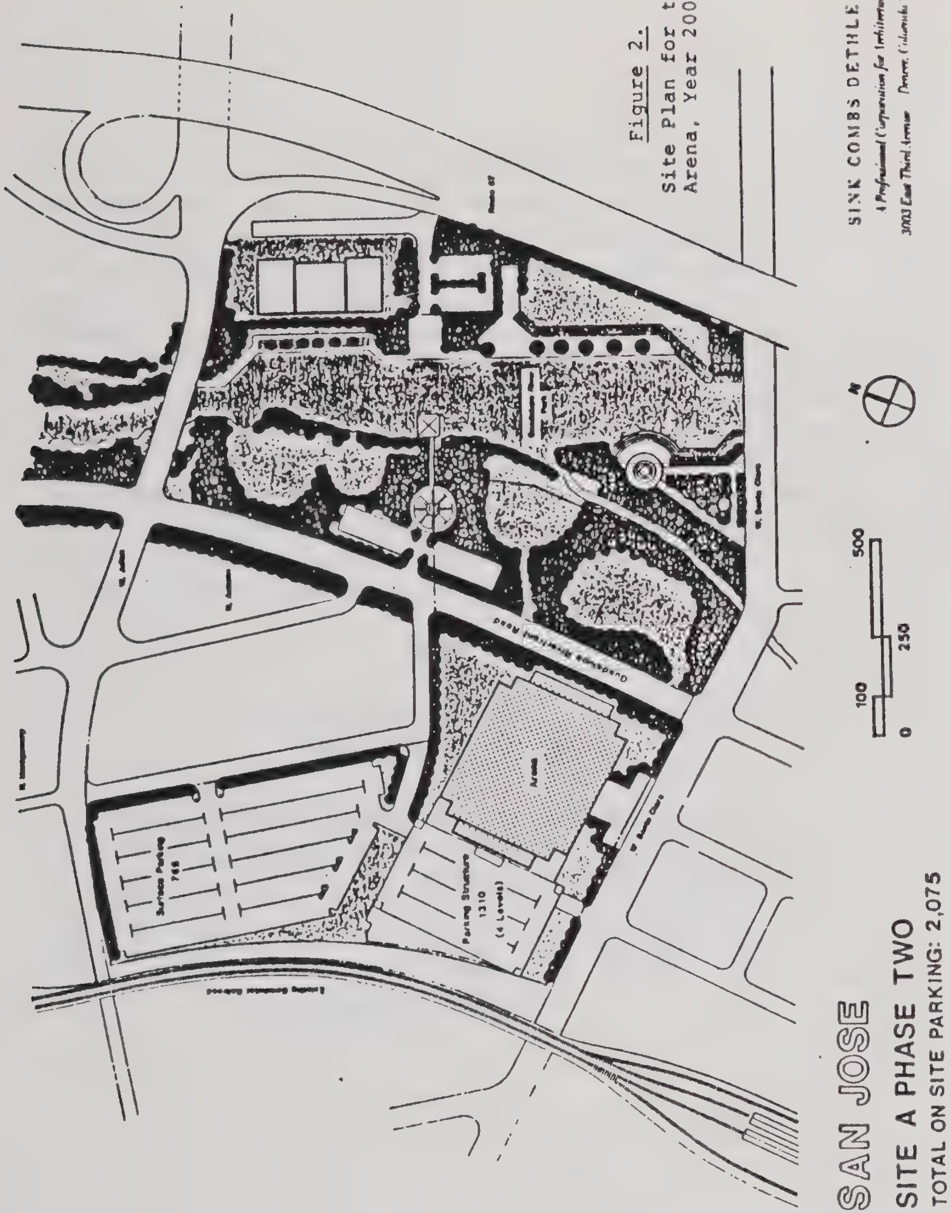


Figure 2. Site Plan for the Arena, Year 2000.

Streets to the north, The Alameda/W. Santa Clara Street to the south, and the Guadalupe Freeway (SR 87) to the east. The existing land use is primarily industrial, with some residential in the northeastern portion of the site. The Guadalupe River crosses the site from north to south.

The San Jose General Plan, Ref. (b), designation for the site is industrial/commercial, except for an open space corridor following the Guadalupe River drainage channel. The existing zoning district for the site is industrial (M-1 and M-4). Surrounding areas are zoned for industrial, commercial and residential land uses.

B. Existing Noise Levels

To determine the existing noise environment, continuous recordings of the sound levels were taken at 3 locations bordering the site, and at 4 locations in the surrounding area. The measurement locations and recorded data are presented in Table I. The measurements were made on February 3, 4, May 27, and June 2 and 12, 1987. The recordings were made with a Gen Rad Company Community Noise Analyzer, which yielded a series of descriptors of the sound levels versus time. The descriptors shown in the table are the L_{10}, L_{50} and L_{90}, i.e., those levels that are exceeded 10%, 50% and 90% of the time. Also shown are the maximum and minimum levels, and the continuous equivalent level (L_{eq}). In addition to these measured levels, the day-night level (L_{dn}) and the Community Noise Equivalent Level (CNEL) are also shown for the three measurement locations near the arena site. The L_{dn} and CNEL are 24-hour noise

descriptors used by the City of San Jose and the Santa Clara County Airport Land Use Commission (ALUC), respectively, to define community noise levels. These descriptors are calculated using the L_{eq} values with the formulae given in Appendix B, and are approximately equivalent. Weighting factors are applied for the evening and nighttime periods to account for an increased sensitivity to noise during these hours. The measurements at the three arena locations and along Coleman Avenue were made for a total period of 3 hours at each location, with two hours measured in the daytime period and one hour measured in the evening or nighttime period. The three off-site locations were measured for one hour each in the evening period, when weekday arena traffic would be most likely to impact the residential areas.

TABLE I

Noise Level Measured at the Proposed Arena Site A and Environs

Location and Time Period	Sound Levels, dBA					
38 Ft. from the C_L of Stockton Avenue, 500 Ft. North of The Alameda:	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}	L_{eq}
3:00 - 4:00 pm	87	67	60	64	47	64
4:00 - 5:00 pm	94*	68	62	54	49	65
9:00 - 10:00 pm	80	69	60	54	50	65

The L_{dn}/CNEL is 69 dB

TABLE I (Con't.)

Location and Time	Sound Levels, dBA					
40 Ft. from the C_L of Julian Street, West of the Guadalupe River:	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}	L_{eq}
5:00 - 6:00 pm	91	73	65	59	51	70
6:00 - 7:00 pm	89	74	67	59	49	72
8:00 - 9:00 pm	94*	66	54	48	46	68

The L_{dn}/CNEL is 71 dB

45 Ft. from the C_L of Santa Clara St., West of Delmas Avenue:						
10:00 - 11:00 am	79	70	64	59	53	67
11:00 am - 12:00 noon	99**	71	64	59	51	72
8:00 - 9:00 pm	87	67	60	57	54	66

The L_{dn}/CNEL is 66 dB

42 Ft. from the C_L of Coleman Avenue, Opposite Hobson St.:						
3:00 - 4:00 pm	96**	76	67	57	51	73
4;00 - 5:00 pm	90	75	68	57	51	72
10:00 - 11:00 pm	87	68	56	50	45	67

The L_{dn}/CNEL is 75 dB

At the Edge-of-Pavement of Hanchett Avenue, East of Tillman Avenue:						
8:00 - 9:00 pm	81	57	50	45	41	57

TABLE I (Con't.)

Location and Time	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}	L_{eq}
At the Edge-of-Pavement of Hanchett Avenue, East of Sequoia Avenue:						
8:00 - 9:00 pm	86	62	50	44	40	60
32 Ft. from the C_L of So. Montgomery Street:						
7:00 - 8:00 pm	91	71	62	55	48	68
At the Edge-of-Pavement of Martin Avenue, East of Sequoia Avenue:						
7:00 - 8:00 pm	83	57	46	42	39	65

Sound Levels, dBA

Note: Highest maximum levels due to:
* Aircraft flyby
** Emergency siren

The existing noise environment at the arena "A" site is controlled by roadway traffic, SPRR train passbys and aircraft approaching the San Jose International Airport (SJIA). Roadway traffic noise impacts are concentrated in the vicinity of Julian Street, The Alameda/W. Santa Clara Street, and Stockton Street. Railroad noise impacts are due to train sources on the main line tracks near the western edge of the site which

are used by the Cal Train commuter rail service, Amtrak passenger trains, and SPRR freight trains. Aircraft landing at SJIA follow a flight path directly over the site, producing noise levels of 65 to 67 dB CNEL.

The calculated L_{dn}/CNEL values shown in Table I reflect noise produced by all of the above described sources, either singly or in combination, depending on the proximity of the measurement location to each source. The L_{dn} and CNEL values were calculated using a decibel average of the measured daytime, evening and nighttime L_{eq} values, as shown in Appendix B. Adjustments were included for average roadway, railroad and aircraft traffic conditions. Where necessary, nighttime L_{eq} values were estimated using procedures developed in Refs. (c) and (d), for roadway and train traffic, respectively. The noise contour map for the SJIA, shown in Ref. (e), was also used in the noise level estimates. Thus, the calculated L_{dn}/CNEL values reveal existing noise levels at the arena Site A varying from 66 to 71 dB. The highest L_{dn}/CNEL occurs at the Julian Street location, and the lowest L_{dn}/CNEL occurs at the Santa Clara Street location. The higher values at the Julian Street and the Stockton Street locations reflect their proximity to aircraft flight paths and the SPRR main line, respectively. In areas surrounding the arena site, the measured L_{eq} values vary from 57 to 68 dBA, with the highest level recorded at the So. Montgomery Street location, and the lowest level recorded at the Hanchett Street location.

Maximum intermittent noise levels (L_{max}) from aircraft sources recorded at the site are up to 94 dBA, with the highest maximum from an aircraft flyby recorded at the Julian Street location. Higher maximum noise levels shown in Table I are from emergency vehicle sirens.

C. Noise Standards

The noise compatibility standards for public buildings and recreational uses, including arenas, are contained in the Noise Element of the San Jose General Plan, Ref. (b). The standards specify a level of up to 60 dB L_{dn} as "acceptable with restrictions", and a level of 70 dB L_{dn} or higher as "generally unacceptable". The site is also located within the 65 dB CNEL contour for aircraft noise from SJIA, and thus falls under the jurisdiction of the Santa Clara County Airport Land Use Commission (ALUC). This agency makes recommendations and sets policies for development within areas impacted by aircraft operations. The ALUC land use compatibility guidelines for recreational land uses, including arenas, specify a level of up to 60 dB CNEL as "satisfactory", a level of 67 to 75 dB CNEL as "cautionary", and areas of 75 dB CNEL or higher to be avoided for these uses, "unless related to airport service". The ALUC guidelines also specify a maximum intermittent interior noise level of 75 dBA for sports arenas.

II. Impacts

The proposed arena Site A would be developed in two phases. Under the first phase, an arena would be constructed, and surface parking would occupy the remainder of the site. Under the second phase, surface parking would be reduced, a parking garage would be constructed, and a park would be created along the Guadalupe River corridor. Project-generated noise impacts involve increased traffic flows on the main streets surrounding the site, noise from inside the arena, and the construction phase noise impacts, as discussed below. Also discussed are traffic noises impacting the arena.

A. Project-Generated Impacts

1. Traffic Noise

Project-generated traffic noise impacting the surrounding area will be created when the arena is being used. Increases in roadway traffic due to arena use would occur mostly during the evening and nighttime hours (4 p.m. to 12 midnight), and on weekends, which will be referred to herein as arena peak hour traffic. These impacts will also be considered in the context of the L_{dn} and CNEL (i.e., over a 24-hour period) in relation to existing and future roadway, railroad and aircraft sources.

By the Year 1991, when the arena is completed, railroad operations on the SPRR main line are expected to remain the same or increase slightly over existing volumes. By the Year 2000, up to 66 commute trains and 3 freight trains would be using the main line near the site, as reported in Refs. (g) and (h).

Aircraft noise levels are expected to remain the same as existing levels or decrease through the Year 2000, as reported by the Noise Control Officer for SJIA, Ref. (i).

Increases in roadway traffic noise are estimated for both Year 1991 and Year 2000 conditions by comparing Average Daily Traffic (ADT) volumes for these years against the existing ADT, as provided by the traffic consultant for the project, Ref. (j).

Increases in the calculated L_{dn}/CNEL from all three traffic sources for both Year 1991 and Year 2000 conditions are shown in Table II. The existing levels are also given for comparison. The future levels are given with and without the arena and are kept separate in order to evaluate the contribution from the arena traffic alone. Although roadway traffic volumes increase significantly, the resulting L_{dn}/CNEL levels due to roadway, railroad and aircraft sources do not increase significantly over existing levels.

The locations shown in Table II correspond to the measurement locations shown in Table I, except for Riverfront Road, which is shown for Year 2000 only when the road will be completed.

TABLE II

Roadway, Railroad and Aircraft Traffic Noise Levels for Existing and Future Conditions, With and Without the Proposed Arena

	Noise Levels (dB L_{dn}/CNEL)				
	Existing	Year 1991		Year 2000	
Location*		w/o Arena	w/Arena	w/o Arena	w/ Arena
Julian St.	71	72	72	74	74
Santa Clara St.	66	67	68	67	67
Coleman Ave.	75	75	75	77	77
Stockton St.	69	71	71	68	68
Riverfront Road, (future only)	--	--	--	67	68

* Locations correspond to measurement location in Table I.

The impact created by the increases in the future levels over existing levels can be assessed using the following criteria developed by the Environmental Protection Agency.

Predicted Impact From Increase Over Existing Noise Levels

Increase in Levels	Assessment	Expected Response
Less than 6 dBA	No Impact	Little comment or individual reaction
6 to 14 dBA	Some Impact	Some individual comment and reaction, no group action is likely
More than 14 dBA	Great Impact	Strong Individual comment and group action

Based on these criteria, it is evident that the noise level increases will have little or no impact on the surrounding areas of the arena site, whether due to general traffic increases or to project-generated traffic.

In addition to the above evaluation, which is in terms of the 24-hour noise analysis, the arena peak hour traffic noise impacts must be considered. While the L_{dn}/CNEL impacts will be minimal, the traffic increases during the times when the arena is being used may create significant noise level increases, especially during the quieter evening and nighttime hours. These predicted increases in the noise levels during the periods when the arena would be in use are shown in Table III. As shown in the table, arena traffic would generate noise levels up to 7 dBA higher than non-arena traffic levels at some locations. In reference to the noise impact criteria given above, arena traffic noise levels would have "some impact" at the Julian Street measurement location.

TABLE III

Noise Level Increases for Measurement Locations During Arena Peak Hour Traffic Periods

Location	Noise Level Increase, dBA Year: 1991	2000
1. Julian Street	3 - 7	2 - 5
2. Santa Clara Street	5 - 6	4 - 5
3. Coleman Avenue	2 - 3	1 - 2
4. Stockton Street	0 - 1	decrease
5. Hanchett Street	2 - 3	1 - 2
6. Martin Avenue	0	0
7. S. Montgomery	0 - 6	0 - 2

As shown, when compared with the L_{dn}/CNEL noise level increases of Table II, it is evident that the arena peak hour traffic noise impacts will be more noticeable than the daily average impacts.

Two other factors that must be considered are the noise level impacts in reference to the applicable standards, and the impacts in terms of the types of land uses that will be affected.

The arena site and the general area surrounding it are already subjected to high noise levels, even for commercial and industrial land uses. Thus, any increase over the existing ambient levels will add to an existing excessive noise environment.

Even though the noise standards apply only to new development, they provide a good general indication of compatible noise levels for existing land uses as well. Consequently, any development located along major thoroughfares, whether existing or proposed, will be impacted by the arena traffic noise.

The area surrounding the site is mostly designated for industrial or commercial land uses, which are usually exposed to higher noise levels than residential areas, and thus, are more tolerant of noise level increases. Therefore, the impacts on these areas will not be significant, especially when considering that the arena traffic impacts will occur at night and on weekends, when many of these uses are non-operative. There is also an area of residential land use along The Alameda that would be impacted by project traffic. Two residential streets (Hanchett Street and Martin Avenue) have been included in the evaluation for Table III, which shows that increases for Hanchett Street of 2 to 3 dB in the ambient noise level could occur during the periods of heavy arena traffic. Thus, based on the impact table, noise level impacts on these residential streets is expected to be minimal. The predicted impacts on other residential streets is expected to be minimal, however, the actual traffic flows using these residential streets is difficult to project with any accuracy using available modeling techniques, as reported by the traffic engineer, Ref. (k). Thus, for purposes of this report, it is assumed that most of the arena traffic would use the major thoroughfares for ingress and egress to the arena, thereby leaving residential streets free of arena traffic. However, the level of service for some

intersections may become so congested during periods of heavy arena traffic that some vehicles may try to bypass the main traffic flow by using parallel residential streets. This would in turn create noise impacts along these streets. An accurate prediction of the impacts on these surrounding streets is not available at this time.

2. <u>Arena Sound Impacts</u>

The preliminary site plan for Site A shows an arena with a floor area of approximately 160,000 sq. ft. With a floor-to-ceiling height of 40 to 50 feet, the total volume of the arena would be in the range of 6,400,000 to 8,000,000 cu. ft. Arenas of this size fall into the "large" category, and require large speaker systems capable of handling several thousand watts of audio power. Typical audience area levels of 110 dBA will be created at times. Thus, a potential for disturbance will exist in the areas surrounding the arena.

The greatest potential for disturbing the surrounding community would be from a roofless structure which would allow sound to escape unimpeded. If a pneumatic structure utilizing a flexible outer skin supported by air is used, sound insertion losses of 25 to 30 dB are attainable, depending on the fabric. Various types of coated fabrics have been used with weights ranging from 400 to 3,700 grams per sq. meter. Material surface weights of this range will yield sound attenuation of 25 to 30 dB at 500 Hertz sound frequencies. Thus, arena interior sound levels of 110 dBA would be reduced to 80-85 dBA in the near field and to 60-65 dBA at 500 foot distances.

An arena roof of fixed or movable design would reduce noise by a minimum of 30 dB for roof surface weights of 1.0 pounds per square foot or more. Thus, such types of roof and wall structures will be adequate for reducing noise escape from the arena. However, noise intrusion from aircraft sources has low frequency components and this factor must be considered in the design of the arena shell.

3. Construction Phase Impacts

During the construction phase of the project, high noise levels in the site vicinity may temporarily be created. The site preparation and construction phases will generate sound levels ranging from approximately 70 to 90 dBA at 50 foot distances from heavy equipment and vehicles. The construction vehicles and equipment generally are diesel powered and produce a characteristic noise which is primarily concentrated in the lower frequencies. Engine noise typically predominates, but additional noise originates from fans and transmission systems.

The total noise energy impacting a receptor point is dependent on the work phases of the construction process, on the distance, and on the angle subtended by the work processes at the noise receptor locations.

The powered equipment and vehicles act as point sources of sound which will diminish with distance over open terrain at the rate of 6 dBA for each doubling of the distance from the source. For example, the 70 to 90 dBA equipment peak noise range at 50 feet will reduce to 64 to 84 dBA at 100 feet, and from 58 to 78 dBA at 200 feet. Therefore, during the

construction operations, sound level increases of up to 20 dBA due to these sources could occur near the project boundary. These impacts would be the most severe along W. Santa Clara Street, as the proposed arena would be located approximately 100 ft. from that roadway.

B. Noise Impacting the Proposed Project

In reference to the standards of the City of San Jose Noise Element and the Santa Clara County ALUC, construction of an arena on the project site would result in exposure of a publicly used building to excessive levels of noise. Levels measured at or near the project site resulted in L_{dn}/CNEL's of up to 71 dB, and maximum levels of up to 94 dBA were recorded for aircraft overflights. In general, noise levels of 60 to 70 dB L_{dn}/CNEL are common over the entire site. Thus, under the City of San Jose standards, placement of the arena at this location would be "acceptable with restrictions", i.e., locating the arena at the site is acceptable on the condition that noise control measures are incorporated into the design. Under the ALUC standards, an arena would be a "cautionary" land use, also indicating that acoustical measures need to be considered in the building design. In addition, maximum noise levels of 94 dBA from aircraft would result in a 19 dBA excess over the recommended maximum interior level of 75 dBA. Noise levels of up to 85 dBA (maximum) from the SPRR main line would also impact the site.

The same restrictions for the arena would also apply to the proposed park along the Gaudalupe River. Thus, some areas of the park, especially near the major roadways (Route 87, West Santa Clara Street, and Riverfront Road) would be subjected to excessive noise levels. In addition, the park is underneath the flight path for SJIA aircraft, and thus, would experience maximum noise levels of up to 94 dBA from this source alone.

Therefore, mitigation measures for the arena and park area will be required to reduce noise to acceptable levels. These measures are described in Section III, below.

III. Mitigation Measures

A. Project - Generated Noise

1. Traffic Noise Impacts

Under the criteria for assessment of impacts, project-generated traffic noise will not be significant in terms of the applicable city and county standards. However, during periods of peak arena traffic, noise impacts may occur at nearby residential areas. Mitigation of these impacts is difficult to achieve with the resources normally available. However, some form of mitigation, such as the use of barricades to block non-arterial residential streets, may help to reduce traffic flows into these areas and maintain the concentration of noise impacts along major thoroughfares, where their impact is not likely to be as severe.

2. Arena Noise Emission Mitigation

Noise impacts generated from within the arena, i.e., crowds, loudspeaker systems, and other sources, will vary in intensity depending on the type of roof used for the structure. Sounds emanating from the arena will be greatest for an open air structure, and the most shielding will be provided by a solid roof structure. Therefore, it is recommended that the arena have, as a minimum, an inflatable or supported fabric roof to contain sounds within the immediate site vicinity.

A solid roof structure (i.e., made with roofing materials having a surface density of 1.0 or more lbs. per sq. ft. on a rigid framework) would provide the most noise shielding for the surrounding areas, and would thus be the more favorable alternative.

It is also recommended that any openings in the arena structure, such as windows, ventilation shafts, or skylights, be designed as controllable openings, so that they are acoustically effective. during periods when the arena is in use, and interior-to-exterior sound transmisison can be kept to a minimum.

B. Mitigation of Noise Impacts on the Arena

The ambient noise levels at the site preclude the use of an open air arena. A roof design of adequate mass with controls on any openings is required to achieve compliance with the standards. The following measures are recommended to achieve maximum noise control for the arena and the park:

- The arena should be designed to achieve a minimum building shell insertion loss of Sound Transmission Class (STC) 30. This rating applies to the roof, walls, windows, doors and all other building shell elements providing a barrier for exterior-to-interior noise transmission.

- No permanent, significant openings should be included between the exterior and interior seating spaces. Thus, some form of mechanical ventilation should be provided. Windows, which may be operable, and doors should provide the STC 30 rating in the closed position. These elements should be maintained closed when the arena is in use. Vestibules may be used for doors requiring more direct access to the exterior.

- In order to provide noise shielding for the park, two alternatives may be considered. The first is to provide noise control barriers along Riverfront Road, W. Santa Clara Street, and S.R. 87, to shield all park areas from noise produced by these traffic sources. The height of the barriers would be dependent on the topography and roadway configurations. Alternatively, these barriers may be omitted if the areas adjacent to the major roadways are kept as low-use areas, either through the use of extensive plantings or other means, and the center of the park is made available for more concentrated use.

C. <u>Construction Noise Mitigation</u>

Mitigation of the construction phase noise at the site can be accomplished by using quiet or "new technology" equipment. The greatest potential for noise abatement of current equipment is the quieting of exhaust noises by use of improved mufflers. Therefore, it is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer. In addition, all equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engine, drive-train and other components.

In addition to the source emission controls, mitigation of construction noise can also be achieved by:

- Scheduling noisy operations for the daytime hours of 7:00 a.m. to 7:00 p.m. to avoid the more noise-sensitive evening and nighttime hours.

A noise reduction benefit can also be achieved by appropriate selection of equipment utilized for various operations, subject to equipment availability and cost considerations. Noise levels should be a consideration in the selection of construction equipment and methods.

The above report presents our noise study findings and recommendations for the planned arena, Site "A", in San Jose. The study findings for existing traffic conditions are based on field measurements and other data and are correct to the best of our knowledge. The future noise level predictions are based on information provided by the traffic consultant, Southern Pacific Transportation Company, Cal Trans, and San Jose International Airport. Significant deviations in the predicted traffic volumes or future changes in motor vehicle or aircraft technology, noise regulations or roadway configurations may produce long-range noise results different from our estimates.

If any additional information or an elaboration of this report is required, please call me.

Respectfully submitted,

Edward L. Pack

Edward L. Pack, Sc.D., P.E.
Principal Acoustical Engineer

ELP:m

Attachment: Appendix A: References

Appendix B: Noise Standards, Terminology, and Acoustical Instrumentation

APPENDIX A

References:

(a) San Jose Arena, Site A Phase One and Phase Two, by Sink Combs Dethlefs,Denver, Colorado, undated

(b) Noise Element of the General Plan, Horizon 2000, City of San Jose, Adopted by City Council, November 1984

(c) Highway Research Board, "Highway Noise, A Design Guide for Highway Engineers", Report 117, 1971

(d) John J. Van Houten, "California Noise Insulation Standards", Noise Control Engineering, Volume 5, No. 2, September/ October 1975

(e) San Jose International Airport, Santa Clara County ALUC Referral Boundary (65 dB CNEL), May 1986

(f) Land Use Plan for Area Surrounding Santa Clara County Airports, Santa Clara County Airport Land Use Commission, August 1973

(g) Information on Future Passenger Train Volumes Provided by Eric Schatmeier, Manager, Planning and Marketing, Cal Train, by Telecon to Edward L. Pack Associates, Inc., June 30, 1987

(h) Information on Existing and Future Freight Train Traffic Volumes Provided by Douglas Rockwell, Southern Pacific Railroad, by Telecon to Edward L. Pack Associates, Inc., June 27, 1987

(i) Information on Future Air Traffic Volumes Provided by Daniel Slowinsky, Noise Control Officer, San Jose International Airport, by Telecon to Edward L. Pack Associates, Inc., June 26, 1987

(j) Information on Existing, Future and Project-Generated Traffic Volumes Provided by Barton-Aschman Associates, by Transmittal to Edward L. Pack Associates, Inc., June and July, 1987

References (Con't.)

(k) Information On Residential Street Traffic Volumes Provided by Maria Lu, Traffic Engineer, Barton Aschman Associates, by Telecon to Edward L. Pack Associates, Inc., July 23, 1987

APPENDIX B

Noise Standards, Terminology and Instrumentation

1. Noise Standards

A. San Jose Noise Element

The San Jose Noise Element uses the day-night level (L_{dn}) noise descriptor to quantify community noise environments. The standards regarding Public, Quasi-Public and Residential Land Uses (including arenas and parks), specify an exterior L_{dn} of up to 60 dB as "satisfactory". An exterior level of 60 to 70 dB L_{dn} indicates an acoustical analysis should be performed to reduce interior noise to acceptable levels, and outdoor activity is limited to acoustically protected areas. Above 70 dB L_{dn}, new development is permitted only if the use is entirely indoors, and if building design limits interior noise to acceptable levels.

B. Santa Clara County ALUC Standards

The Airport Land Use Commission of Santa Clara County specifies exterior levels of up to 65 dB CNEL as "satisfactory" for recreational uses, including arenas. Levels of 65 to 75 dB CNEL indicate "caution", i.e., noise insulation needs must be carefully reviewed. Above 75 dB CNEL, recreational land uses should be avoided "unless related to airport service". The ALUC also specifies a maximum intermittent noise level of 75 dBA for sports arenas. These standards utilize the Community Noise Equivalent Level (CNEL) descriptor, which is approximately equivalent to the day-night level.

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the Community Noise Analyzer. Some of the statistical levels used to describe community noise are defined as follows:

L_{10} - A noise level exceeded for 10% of the time, considered to be an "intrusive" level.

L_{50} - The noise level exceeded 50% of the time, representing an "average" sound level.

L_{90} - The noise level exceeded 90% of the time, designated as a "background" noise level.

L_{eq} - The continuous-equivalent level is that level of a steady noise having the same energy as a given time-varying noise. The L_{eq} thus represents the decibel level of the time-averaged value of sound energy or sound pressure squared. The L_{eq} is the noise descriptor used to calculate the L_{dn} and CNEL descriptors.

B. Day-Night Sound Level (L_{dn})

Noise levels utilized in the standards are described in terms of the day-night sound level (L_{dn}). The L_{dn} rating is determined by the cumulative noise exposures occurring over a 24 hour day in terms of A-weighted sound energy. The 24 hour day is divided into two subperiods for the L_{dn} index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m., and the nighttime period from 10:00 p.m. to 7:00 a.m. A 10 dBA weighting factor is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The L_{dn} is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$L_{dn} = [(L_d + 10 \log_{10} 15) \,\&\, (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24$$

where:

$L_d = L_{eq}$ for the daytime (7:00 a.m. to 10:00 p.m.)
$L_n = L_{eq}$ for the nighttime (10:00 p.m. to 7:00 a.m.)
24 indicates the 24 hour period
& denotes decibel addition

C. Community Noise Equivalent Level (CNEL)

The CNEL is a measure of the cumulative noise exposure over a 24 hour period. The CNEL index divides the 24 hour day into three subperiods, i.e., the daytime (7:00 a.m. to 7:00 p.m.), the evening (7:00 p.m. to 10:00 p.m.) and the nighttime (10:00 p.m. to 7:00 a.m.), and also applies weighting factors of 5 and 10 dBA to the evening and nighttime periods, respectively, to account for the greater sensitivity of people to noise during those periods. The CNEL values are calculated from the measured L_{eq} values in accordance with the following mathematical formula:

$$\begin{aligned} CNEL = [(L_d + 10 \log_{10} 12) \ \& \ (L_e + 5 + 10 \log_{10} 3) \\ \& \ (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24 \end{aligned}$$

where:

$L_d = L_{eq}$ for the daytime (7:00 a.m. to 7:00 p.m.)
$L_e = L_{eq}$ for the evening (7:00 p.m. to 10:00 p.m.)
$L_n = L_{eq}$ for the nighttime (10:00 p.m. to 7:00 a.m.)
24 indicates the 24 hour period
& denotes decibel addition

D. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighting network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of a Gen Rad Company Community Noise Analyzer, which provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the analyzer was provided by a microphone extended to a height of 5 ft. above the ground. The "A" weighting network and the "Fast" response setting of the analyzer were used in conformance with the applicable standards. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

APPENDIX A-4

GEOTECHNICAL ANALYSIS

EARTH SYSTEMS CONSULTANTS

PALO ALTO, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

GEOTECHNICAL REPORT

PROPOSED SAN JOSE ARENA - SITE A

San Jose, California

Prepared for

DAVID J. POWERS & ASSOCIATES

San Jose, California

By

EARTH SYSTEMS CONSULTANTS
1900 Embarcadero Road
Palo Alto, California

JULY 1987

Earth Systems Consultants

GEOTECHNICAL ENGINEERING • ENGINEERING GEOLOGY • ENVIRONMENTAL GEOLOGY

File No. C6-2280-C1
July 20, 1987

Mr. David J. Powers
David J. Powers & Associates
1885 The Alameda, Suite 210
San Jose, California 95126

Subject: Proposed San Jose Arena - Site A
San Jose, California
GEOTECHNICAL REPORT

Gentlemen:

We are pleased to submit the enclosed report which presents the findings of our geotechnical study and evaluation of Site A. Site A is one of three sites in San Jose that is being considered as a possible location for the proposed multi-purpose civic arena.

Our report concludes that from a geotechnical point of view, this site is considered suitable for the proposed development. The geologic conditions that would impact upon the project are identified and evaluated in the report. The enclosed recommendations outline measures that could be implemented to mitigate those conditions that were identified as having a potentially adverse impact upon the development. The report also includes recommendations concerning which types of foundations would be suitable for an arena built on this site.

It was a pleasure to work with you on this most interesting project. If you have any further questions please do not hesitate to contact our office. This report completes our current assignment on this project.

Very truly yours,

EARTH SYSTEMS CONSULTANTS

Bruce O'Neill

Bruce O'Neill, Project Engineer

Reviewed by:

Murray Levish, C.E.G. 194

John P. Nielsen, C.E. 16113

BON/ML/JPN:tm

Copies: 2 to David J. Powers & Associates

CONTENTS

CONTENTS - continued

GEOTECHNICAL REPORT

SUBJECT: PROPOSED SAN JOSE ARENA - SITE A
SAN JOSE, CALIFORNIA

CLIENT: DAVID J. POWERS & ASSOCIATES

INTRODUCTION

There is a proposal that a 20,000 seat multi-purpose arena be built in San Jose. Three possible sites for the arena are currently being studied: Site A, Site B and Site C. This Geotechnical Report presents the results of our geotechnical evaluation of Site A. Site A is located between the Guadalupe River and the Southern Pacific Railroad tracks in central San Jose (see Figure 1, page 4). West St. John, Montgomery, and West Julian Streets form the northern boundary of the site. West Santa Clara, North Montgomery, and Crandall Streets form the southern site boundary. The evaluations of Sites B and C are presented in separate reports.

Proposed Development

If the arena is built on Site A, it is currently proposed that it will be located at the northwest corner of Santa Clara and Autumn Streets (see Figure 2, page 5) which is in the central portion of Site A. The Project Architect, Sink Combs Dethlefs, has indicated that the arena will be a predominantly concrete structure with metal framing supporting the roof and will be approximately 350 feet by 450 feet long. The heavy, unitized concourse portion of this structure is expected to be a relatively rigid body that will

respond to movement as a unit, whereas the metal framed roof is a relatively flexible structure. This combination of structural elements should produce a structure that is relatively insensitive to differential settlement of the supporting soil. It is anticipated that the arena will have a 15-foot-deep basement, and that the foundation loads will be concentrated near the perimeter of the building. Preliminary estimates made by the Project Structural Engineer indicate that each column will support approximately 250,000 pounds.

Surface parking will be provided around the arena and a parking structure may be constructed in the southwest corner of the site. It is anticipated that the parking structure will be constructed with reinforced concrete columns, beams, and shear walls and will be less tolerant to differential settlement than the arena. The final size of the parking structure has not been determined, however if the largest structure under consideration is built, the Project Structural Engineer estimates that the column loads will be approximately 1000 kips. In the event that a parking structure is not built, additional surface parking will be provided in the northwest corner of the site (see Figure 2).

Purpose and Scope

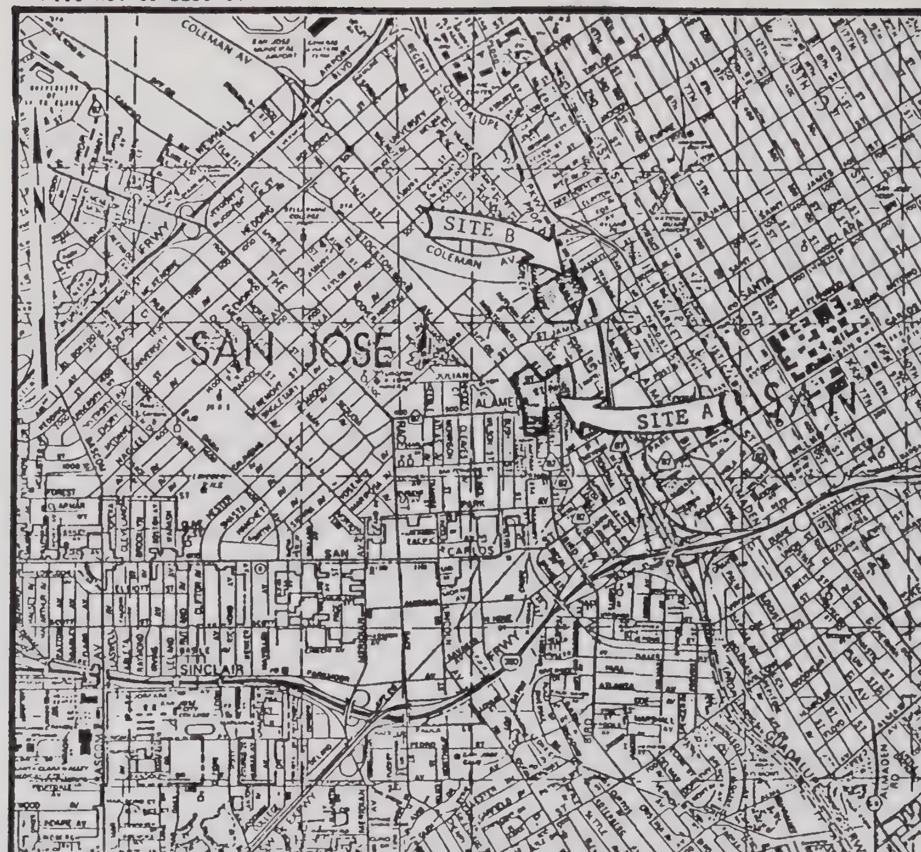
The purpose of this study was to evaluate the geologic and seismic conditions at this site; to evaluate the behavior of the soils under earthquake-induced vibrations and under the loading imposed by the proposed arena; and to discuss the suitability of the proposed site with regard to the construction of an arena facility.

This study included a review of pertinent geotechnical literature and maps; execution of four cone penetrometer probes; drilling and sampling from six exploratory borings; laboratory testing of some of the retrieved samples; analysis of the data obtained by these programs; and the preparation of this report.

Conclusions presented in this report are based on the data acquired and analyzed during this study. This report is intended to be an addendum to the Environmental Impact Report being prepared for the project and should be used for planning purposes only. Further detailed site investigation and data analysis will be required in order to develop specific foundation recommendations and soil design parameters.

Site Description

Site A is relatively level and is approximately 15 to 20 feet above the level of the adjacent Guadalupe River bed. The site is occupied by a car dealership, a PG&E yard, and other small businesses. The entire site is developed, and there is no exposed natural ground. The configuration of the adjacent Guadalupe River banks vary significantly along the length of this property. Portions of the bank are retained with vertical concrete walls, and others are partially vegetated and exist at slopes that vary from approximately 1:1 to 2:1 (horizontal to vertical). The bottom of the river appears to be unlined along the section adjacent to this site.



0 ½ 1

APPROXIMATE SCALE IN MILES

LOCATION MAP

Proposed San Jose Arena - Sites A and B
San Jose, California

Base: Thomas Bros. Map Book 40256

Figure 1

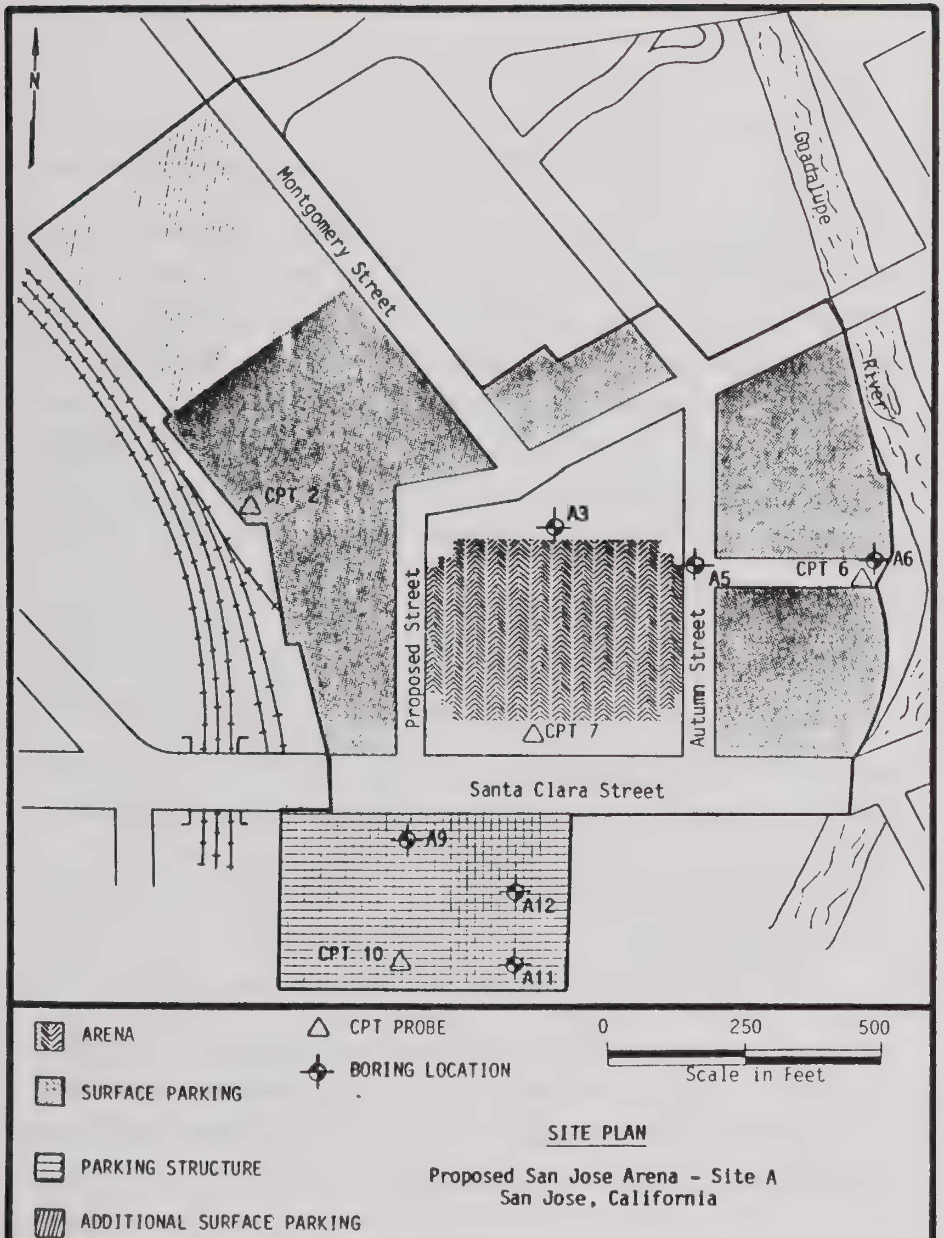


Figure 2

PROCEDURES AND RESULTS

Geologic Setting

Site A is located in the Santa Clara Valley, between the base of the western foothills of the Hamilton-Diablo Mountain Range and the northeastern foothills of the Santa Cruz Mountains in the Coast Range Geomorphic Province of Central California. Bedrock in this area is the Franciscan Complex, a diverse group of igneous, sedimentary and metamorphic rocks of Upper Jurassic to Cretaceous age (70 to 140 million years old). These rocks are part of a northwest-trending belt of material that lies along the east side of the San Andreas Fault system, which is located approximately 11.5 miles southwest of this site. Geologic cross sections of the area contained in California Department of Water Resources Bulletin No. 118-1 (1975) indicate that the depth to bedrock in this area is in excess of 600 feet.

The Franciscan rocks are overlain, in this area, by marine and non-marine sediments of Cretaceous to Plio-Pleistocene age (80 to 2 million years old), which are, in turn, covered with alluvial, fluvial, lacustrine and bay deposits of Pleistocene to Holocene age (less than 2 million years old).

The regional geology has been mapped by Davis and Jennings (1954), Nilsen (1972), Rogers and Williams (1974), and Helley and Brabb (1971). These maps differ in scale and detail, but they generally agree that the site is underlain at the surface by fine-grained non-marine sediments of undetermined depth. The latter two references divide the materials on the site into fluvial deposits from the edge of alluvial fans (fine sand, silt and clay),

and interfluvial basin deposits (organic and silty clay). This latter unit is shown as a thin band along the western end of the site.

The U.S. Department of Agriculture (1968) has mapped three agricultural soils on this site. The three soil types lay in broad, northwest-trending bands, roughly parallel to Guadalupe River to the east. The Sunnyvale silty clay lies on the west side of the site. This soil has an effective depth of 60 inches and a high shrink/swell potential. The remainder of the site is occupied by two members of the Campbell silty clay loam, which has an effective depth of 36 to 60 inches, and a moderate shrink/swell potential. The distribution of these materials on the site is shown in Figure 3 (page 8).

Seismic Setting

None of the references studied show a fault on this site. Faults mapped in the site vicinity are shown on Figure 4 (page 9).

The closest fault to the site is the Silver Creek Fault, which has been mapped approximately 1.8 miles to the northeast (California Department of Water Resources, 1963). Davis and Jennings (1954) and Rogers and Williams (1974) show the Silver Creek Fault to end at the north end of Silver Creek Canyon, about 5 miles southeast of the site. This fault was first mapped by Crittenden (1951) and was described by him as a branch of the Calaveras.

Jennings (1975) shows the Silver Creek to be a "Quaternary" fault, or one that has displayed movement between 200 and 2,000,000 years ago. United Soil Engineering (1978) indicates that the youngest sediments affected by the Silver Creek Fault are 500,000 years old. The Silver Creek has been designated

0 3000
SCALE IN FEET

SOILS

Proposed San Jose Arena Sites A and B
San Jose, California

Sv	SUNNYVALE SILTY CLAY
Cc	CAMPBELL SILTY CLAY LOAM, CLAY SUBSTRATUM
Ca	CAMPBELL SILTY CLAY LOAM
Ch	CLEAR LAKE CLAY
YeA	YOLO SILTY CLAY LOAM

FROM USDA (1968)

Figure 3

0 5
Scale in Miles

- ARENA SITE
- ACTIVE FAULT
- POTENTIALLY ACTIVE FAULT
- EARTHQUAKE EPICENTERS OF MAGNITUDE 0.5 OR GREATER (1969-1970)

Compiled from Brown & Lee, 1971; Rogers & Williams, 1974; and California Division of Mines and Geology, 1982

REGIONAL FAULT MAP

Proposed San Jose Arena
Sites A, B and C
San Jose, California

Figure 4

as a potentially active fault by Cooper-Clark and Associates (1974) and the Santa Clara County Planning Department (1975). Helley and Brabb (1971) show undisturbed Quaternary sediments in the valley across the projected trace of the Silver Creek Fault.

The Evergreen Fault has been mapped approximately 5.4 miles northeast of this site, near the base of the hills (Rogers and Williams, 1974; Dibblee, 1972). This fault is shown by Jennings (1975) to be "Quaternary." Cooper-Clark and Associates (1974), Rogers and Williams (1974) and the Santa Clara County Planning Department (1975) show this fault to be potentially active.

In 1978, Berlogar, Long and Associates conducted a study of the Mirassou Winery property (located southeast of this site), during which they trenched across the mapped trace of the Evergreen Fault. No evidence of faulting was found along the trace mapped by Dibblee (1972) and Cooper-Clark (1974).

Approximately 900 feet east of Dibblee's trace, one of Berlogar, Long's trenches exposed geologic features that were interpreted by them as indicative of faulting. The "East Evergreen Fault" was zoned under the provisions of the Alquist-Priolo Special Studies Zones Act, based on Berlogar, Long's 1978 reports.

The Special Studies Zone originally established on the Evergreen Fault followed the traces mapped by Dibblee (1972), and has subsequently been removed from the most recent maps. Further exploration of that site by Earth Systems Consultants (1984) failed to produce any evidence of active faulting along either the Evergreen or East Evergreen Faults.

The Crosley Fault has been mapped along the base of the hills, approximately 5.5 miles northeast of the site (Rogers and Williams, 1974; Dibblee, 1972). This fault has been classified as potentially active by Rogers and Williams (1974) and by the Santa Clara County Planning Department (1975). Jennings (1975) shows it to be a "Quaternary" Fault, or one that has moved between 200 and 2,000,000 years ago. This fault does not appear on the maps by Crittenden (1951), Davis and Jennings (1954) nor Brown and Lee (1971). Dibblee (1973) was the first to map a continuous fault along the base of the hills in eastern San Jose. This exposure was surveyed and confirmed by Burkland and Associates during a study of the Minoli property, south of Crosley Creek (Burkland and Associates, 1977b).

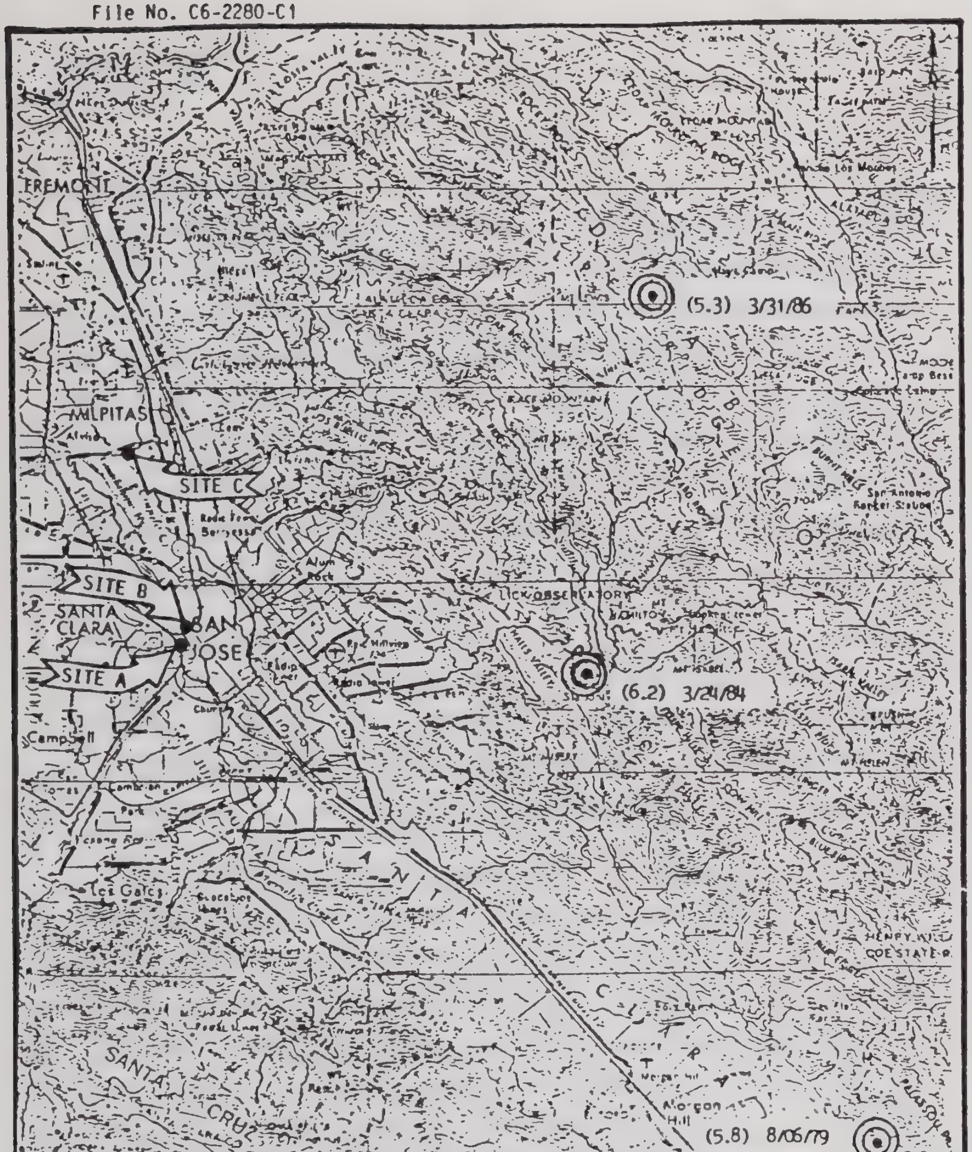
The active Hayward Fault has been mapped approximately 6.8 miles northeast of the site (Dibblee, 1972; Rogers and Williams, 1974; California Division of Mines and Geology, 1982). This fault is known to be creeping in Fremont, northwest of the site, and often acts as a water barrier. Ground rupture occurred along parts of the Hayward Fault from Warm Springs northward during the earthquakes of 1836 and 1868 (Radbruch-Hall, 1974).

The Sargent-Berrocal Fault has been mapped 7.3 miles southwest of the site. This section of the fault is considered to be potentially active.

The Calaveras Fault, 8.1 miles northeast of the site, and the Hayward Fault, are both part of the regional San Andreas Fault system. The main trace of the San Andreas is located about 11.5 miles southwest of the site, in the Santa Cruz Mountains. All three of these faults have been zoned by the California Division of Mines and Geology (1982).

A number of major earthquakes are known to have occurred in the vicinity of the site. The October 8, 1865 earthquake (estimated Richter magnitude 6.5) was centered on the San Andreas Fault, approximately 13 miles west of the site. The epicenter of the October 21, 1868 event (estimated Richter magnitude 7.0) has been located at a point approximately 14 miles northwest of the site on a branch of the Hayward Fault. The epicenter of the earthquake of April 18, 1906 (Richter magnitude 8.3), originally plotted in Olema, Marin County, has been relocated to a point in northern San Mateo County, approximately 38 miles northwest of the site (Real et al., 1978). The July 1, 1911 earthquake (estimated Richter magnitude 6.6) is plotted as having occurred approximately 8 miles southeast of the site. The location of that epicenter is uncertain and it has not been ascribed to movement on any particular fault. The 1979 Coyote Lake (Richter magnitude 5.8), and the 1984 Halls Valley (Richter magnitude 6.2) earthquakes were centered on the Calaveras Fault approximately 27 and 12 miles east of the site. The 1986 earthquake near Mt. Lewis (Richter magnitude 5.3) was centered approximately 8 miles northeast of the site and was not ascribed to a known fault (see Figure 5, page 13).

The site has been classified by Rogers and Williams (1974) according to its seismic hazard potential. It is located within their zone D1-2, which includes areas in which the groundwater table is 10 to 20 feet below the surface, and where there is a high potential for seismically-induced liquefaction.



0 5
Scale in Miles

(5.3) Richter Magnitude

LOCATION OF RECENT NEARBY
MAJOR EARTHQUAKE EPICENTERS

Proposed San Jose Arena Sites A, B and C
San Jose, California

Figure 5

The map prepared for use in preparing the Santa Clara County Seismic Safety Plan (Seed, 1974) places this site in the category "Possible Liquefaction, Requires Investigation." This map indicates that the estimated characteristic period of the soil deposit is between 1.2 and 2.0 seconds.

The soil reports for two nearby projects were on file in the City of San Jose Public Works Department. Applied Soil Mechanics, 1987, was prepared for a project on the southeast corner of West Julian and Montgomery. Terrasearch prepared a report in 1974 for a project across the Guadalupe River from the southeast corner of the subject site.

Both reports found that there was a low to moderate potential for strength loss to occur in the sand layers that had been encountered during drilling. Applied Soil Mechanics determined that the layers encountered were too dense and contained too many fines to liquefy, and the hazard was further reduced because the sand lenses were thin and discontinuous. Also, no significant groundwater was encountered. Terrasearch found thicker layers of sand (up to 13 feet thick) between depths of 9 and 20 feet below the surface. They also found a water table in or above these sand layers. The sand had a predominance of fines, the clay layers above were thick and the N values were reported to be greater than 16 blows per foot (the boring logs however have few "N" value notations). Terrasearch concluded that there was a low to moderate potential for strength loss to occur in the sands during a seismic event.

Subsurface Exploration

The subsurface exploration program at this site consisted of two phases; cone penetration testing and exploratory drilling. The locations of the probes and borings were distributed to cover the entire site with a concentration around the proposed location of the arena and the parking structure. The approximate locations of the probes and borings are shown on Figure 2. Access to the site during the subsurface exploration was restricted, and the field work was confined to the City streets. Note that the CPT and Boring numbers are indicative of a location and do not reflect the number of probes or borings placed during this study.

Cone Penetration Testing

An electronic cone penetrometer (CPT) was used to probe the site at four locations on May 20, 1987. The probes ranged in depth from 37 to 78 feet. Information derived from the cone probes included a continuous profile of site stratigraphy, and correlations with various soil strength parameters.

A CPT is a 1.4-inch diameter steel cone which is instrumented to record the bearing pressure on the tip of the cone (tip resistance), the friction along a 4-inch long segment of the probe (local friction), and the pore water pressure behind the tip of the cone. Plots of the tip resistance, the local friction, the friction ratio (local friction/tip resistance), the pore pressure and the differential pore pressure ratio (measured pore pressure minus hydrostatic pore pressure all divided by tip resistance) are

presented in Appendix A. The cone measures these values continuously and records a set of measurements every 2 inches. The cone is pushed into the ground with a hydraulic press which is mounted on a conventional drill rig truck.

Based on empirical correlations, the parameters measured by the cone penetrometer can be used to infer the soil type, the relative density of the soil, the angle of internal friction, the equivalent N value (standard penetration test blow count), the cyclic stress ratio, and the undrained shear strength of the soil. The validity of empirical correlations is greatly enhanced when confirmed with local experience. For that reason, an exploratory boring was placed adjacent to CPT Probe 6. The interpretation of these parameters, based on the empirical correlations, has been computerized. Due to the volume of output accumulated, the processed data is not presented in this report. The data is stored in the files of Earth Systems Consultants, and is available upon request. Included with the other plots of the cone data are interpreted plots showing the generalized stratigraphy, and some of the relevant soil properties as derived from the empirical correlations.

Drilling and Sampling

The second phase of the subsurface exploration program consisted of the drilling and sampling of six test borings on May 28 and 29, 1987. One boring was placed adjacent to the location of CPT Probe 6 to aid in developing on-site correlations between the CPT data, the visual classification of the material, and the soil parameters measured in the

laboratory. The other borings were spaced across the site to aid in developing information relative to the site profile and the general subsurface soil and geologic units. The borings were advanced with a truck-mounted drill rig equipped with 8-inch diameter, hollow stem, continuous flight augers. Boring depths ranged from 38½ to 40 feet below the existing ground surface. According to the Santa Clara Valley Water District, exploratory borings placed below 50 feet require special measures to seal the boreholes to prevent possible cross contamination of water aquifers. In the site selection phase of the geotechnical evaluation we were requested by Mr. David J. Powers to not complicate the investigation in that manner, thus the borings were restricted to a depth of 45 feet during this phase of the investigation.

Each boring was visually logged in the field by a field engineer. Relatively undisturbed samples were obtained by using a 3-inch O.D. Modified California Sampler lined with 2½-inch O.D. by 6-inch-long brass tubes. The sampler was driven 18 inches into the soil using a 140-pound hammer falling 30 inches with an estimated efficiency of 60 to 70 percent. The number of blows required to drive the sampler the final 12 inches are recorded on the boring logs, which are presented in Appendix A. Pocket penetrometer tests were run on most of the samples to develop an initial estimate of the variation of shear strength with depth. The stratification lines on the boring logs represent approximate boundaries between soil types, but the actual transition may be gradational.

Laboratory Testing

The laboratory testing program was directed toward determining some of the physical and engineering properties of the soils on the site and developing local correlations with the CPT output. The results of the laboratory tests are presented in Appendix B.

Strength parameters of selected samples were determined by means of direct shear tests run on "undisturbed" samples. The samples were soaked for 24 hours prior to shearing. The direct shear tests were run at a constant rate of strain on unconsolidated samples that were free to drain. Strength parameters of selected samples of the cohesive soils were determined by means of unconfined compression tests.

Consolidation tests were run on two representative clay samples to determine the compressibility of the material. Sieve analyses and hydrometer analyses were performed on selected samples of the granular material to determine the grain size distribution. Moisture/density tests were run on those samples not otherwise selected for testing.

Soils and Subsurface Materials

There are six major material types that were identified during the field investigation. However, the soil profile underlying this site is highly variable. Some of the material types are not present in some locations, and those present vary in thickness and location below the ground surface.

Unit 1: The uppermost unit on this site is a miscellaneous fill. It varies in thickness from 2 to 11 feet and contains silty clays, sandy silts, and sand with gravel and debris.

Unit 2: The uppermost natural soil unit is a dark grey, highly plastic clay. This unit varies in thickness from 2 to 5 feet and is not present in some locations.

Unit 3: Below the highly plastic clay is a layer of light grey sandy clay with orange mottling. This unit is softer and less plastic than the overlying unit. Unit 3 varies in thickness from 0 to 11 feet.

Unit 4: Beneath the sandy clay unit is a layer of tan silty sand. In one location this material consists of predominantly fine to coarse gravel with a silty sand matrix. Unit 4 varies in density from loose to dense and in thickness from 4 to 11 feet.

Unit 5: This unit consists of a blue grey to dark grey predominantly silty clay with some clayey silt and sandy clay. This material varies in consistency from soft to very stiff. In the borings, this material was observed to vary in thickness from 10 to 23 feet. In CPT Probe 6, this unit appears to extend to a depth of 75 feet, and in CPT Probe 10 to a depth of 66 feet. In several locations, this material is interbedded with Unit 4 material.

Unit 6: Four of the six borings at this site terminated in Unit 6 material which consists of fine to coarse gravel with a sand matrix. This material is dense to very dense.

Groundwater

The groundwater level was determined during the field exploration program to vary from between 17 to 47 feet below the ground surface. The groundwater level was visible in three of the borings and was determined during two of the CPT probes by pausing and allowing the excess pore pressures generated by the probe to dissipate.

Boring / CPT Probe	Depth Below Ground Surface
Boring 3	18 feet
Boring 5	20 feet
Boring 6	17 feet
Boring 9	NGWE*
Boring 11	NGWE*
Boring 12	NGWE*
CPT Probe 2	Not determined
CPT Probe 6	47 feet
CPT Probe 7	Not determined
CPT Probe 10	47 feet

*No groundwater encountered during drilling.

CPT Probes 6 and 10 were at opposite ends of the site, so it appears that the level of the regional groundwater table which these probes measured is relatively constant at this site. Borings 3, 5 and 6 which are near the river, encountered a perched groundwater table at between 17 and 20 feet. The thickness of the perched groundwater table was not determined. No groundwater was encountered in Borings 9, 11 and 12. This indicates that if the arena is to be constructed with a 15-foot-deep basement, some dewatering will probably be required during construction. The perched groundwater will also be a factor that needs to be considered when designing the basement. Note that these measurements were taken in late May, 1987. The rainfall during the previous winter was below average, and the groundwater level during or after construction may be higher.

Response of the Soils to Seismic Loading

Some of the soils at this site may liquefy when subjected to seismic loading. Liquefaction is a phenomenon that occurs when loose, granular soils are subjected to strong ground shaking. Under these conditions, the granular soils will attempt to densify, resulting in the development of excess pore pressures which impedes densification. If the pore pressures cannot dissipate as rapidly as they are generated, the soil behaves like a heavy, viscous fluid. Under these conditions, the soil will loose shear strength, and if the imposed shear stresses (due to structural loading, or the presence of a nearby slope) exceed the soil strength, the "liquified" soil will "flow." This can lead to slope or foundation failures. Where the soil is confined or there are no imposed shear stresses, no movement occurs except for some possible areal or local settlement.

If the soils are only partially saturated, there is no impedance to densification, and as a result local and/or areal settlement occurs.

The susceptibility of the soils to liquefy depends on the degree of shaking to which they are subjected, the density of the soils, the amount of fine grained material in the soil, the confining pressure (the depth below the ground surface), and the degree of saturation.

The potential ground shaking at this site was estimated using the methods suggested by Seed and Idriss (1982). The site is located 6.8 miles from the Hayward Fault (maximum probable earthquake M = 7.0), and 11.5 miles from the

San Andreas Fault (maximum probable earthquake M = 8.3). It is estimated that the maximum probable earthquake on the Hayward Fault would cause 10 to 15 cycles of significant shear stress at this site, with a maximum ground acceleration of 0.28g. Significant shear stress is defined as two-thirds the maximum shear stress developed during the earthquake. It is estimated that the maximum probable earthquake on the San Andreas Fault would cause 20 to 25 cycles of significant stress with a maximum ground acceleration of 0.24g.

A perched groundwater table was observed across parts of this site at a depth that ranged from 17 to 20 feet below the current ground level, but this groundwater was not encountered in other parts of the site. The regional groundwater level was measured with the CPT to be approximately 47 feet below ground level. The degree of saturation of the material between these two levels is unknown. This is important because saturated soils are more prone to liquefy than partially saturated materials. However, partially saturated soils are more prone to densify under cyclic loading.

Liquefaction is primarily confined to granular soils with a clay content of less than 15 percent. Sieve analyses and hydrometer analyses of several of the materials suspected of being susceptible to liquefaction were performed in the laboratory to determine their grain size distribution. The results of these tests which are presented in Appendix B confirmed the field classification of the material and indicated that they have an insufficient percentage of fine grained material to provide internal cohesion and prevent liquefaction.

Cyclic shear stress ratios (shear stress/confining pressure) are an indication of the susceptibility of a soil to liquefy. Our estimate of the cyclic stress ratios required to cause the soil to liquefy were derived from correlations with the CPT data and are based on work by Robertson and Campanella (1986). The potential cyclic shear stresses that could be generated by the maximum probable earthquake were compared with the cyclic stress ratios that would cause the soil to liquefy, to identify layers where a potential problem exists.

The following table shows the location of the layers of potentially liquefiable soils identified at this site.

Boring / CPT Probe	Depth to Potentially Liquefiable Soil
Boring 3	15-21 feet
Boring 5	12-16 feet
Boring 6	7-18, 21-23 feet
Boring 9	--
Boring 11	--
Boring 12	--
CPT Probe 2	43, 55-58, 60-61, 64 feet
CPT Probe 6	3-4, 18, 23-25, 36, 53-54 feet
CPT Probe 7	--
CPT Probe 10	43, 59-60 feet

Response of the Site Soils to Loads Imposed by the Structures

Compressibility

If the arena is supported on a shallow foundation the primary response of the site soils to the loads imposed by the arena will be to compress and cause settlement. The compressible soils that will have the most impact on this project are the Unit 5 materials between the foundation footings and a

depth of 40 feet (which is estimated to be the approximate limits of the zone of influence of the footing pressure). In the southwest corner of the site, the compressible soils begin at the anticipated level of the foundations (17 feet) and extend to a depth of 32 to 40+ feet below the surface. In other areas, such as at Borings 3 and 5 and CPT Probe 7, the depth of affected compressible material is only on the order of 9 to 11 feet. The difference in the thickness of compressible soils below the arena will probably cause different amounts of settlement in various portions of the arena.

Initial estimates of the settlement and differential settlement that would occur indicate that they would be within tolerable limits for this type of structure provided that the foundation acted as a unit.

Materials Able to Support Deep Foundations

CPT Probes 2, 6 and 10 indicate that there is a dense layer of granular material (Unit 6) underlying this site at a depth of between 66 and 74 feet below the existing ground surface. The capacity of the CPT was reached on each of these holes so the thickness of this layer was not determined. This layer of material would probably provide excellent bearing capacity for deep end-bearing piles. Borings 3, 5, 9 and 11, and CPT Probes 2 and 7 indicate that there are intermittent shallower layers of this material on the site. The shallower layers could be a serious impediment to driving piles down to the lower granular material. In some areas, the shallower layers may be capable of supporting end bearing piles.

Suitable Foundation Types

Suitable foundation types for the major and minor structures on this site are discussed below. Suitable foundations must be able to sustain seismic loading, settlement due to consolidation of the underlying soils, possible areal settlement of the underlying soils during an earthquake, and the loads imposed by the proposed arena. In order to provide soil design parameters, additional site investigation work will be required.

a. **Conventional Spread Footings**

Conventional spread footings may be suitable for this project if the concourse portion of the structure is sufficiently rigid that the footings will act as a unit and not independently. The differential settlement of footings that are able to act independently due to consolidation of the upper soils and the possible dynamic consolidation of the granular deposits during an earthquake will probably exceed tolerable limits for independent footings. Unitized, conventional spread footings may be suitable for minor one- or two-story light weight structures such as ticket sales offices, etc.

b. **Mat Foundation**

If conventional spread footings can not be adequately tied together, a unitized mat foundation may be a suitable foundation for the arena on this site. The prime advantage of this system is that the structure would respond as a unit to differential settlement of the underlying soils and could span any localized soft areas.

c. **Compensated Foundation**

The bearing capacity of the foundation could be increased, and the amount of post-construction settlement decreased if a compensated foundation was constructed rather than a mat foundation. A compensated foundation is similar in form to a mat foundation, except that the depth of the foundation is increased. A fully compensated foundation is one where the weight of the structure matches the weight of the soil that is excavated from the site. The depth of a compensated foundation may be restricted by the groundwater level, because of the need to dewater. The dewatering would be limited to the perched groundwater.

d. **Piles**

Driven piles could be used to construct suitable foundations for the structures on this site. The piles could be designed to develop bearing capacity with skin friction or by end-bearing on the dense sands and gravels found below this site. The depth to the bearing layer varies across the site. Dense intermediate level soil layers that may increase the difficulty of driving piles to the bearing layer were encountered in some locations. It may be possible to pre-drill holes through these layers, and then drive piles in these holes down to the bearing stratum.

e. **Drilled Piers**

If drilled piers are used at this site, it is expected that the pier holes will need to be cased to prevent collapsing, and that drilling mud may be required to prevent the saturated silty sands from flowing into the bottom of the pier hole. Unless specific structures or installations, that are

susceptible to vibrations caused by pile driving, are identified in the vicinity of the arena and parking garage, drilled piers appear to be a less suitable foundation than driven piles.

CONCLUSIONS

The conclusions contained herein are based on the data acquired and analyzed during this study.

General

1. From a geotechnical viewpoint, this site is considered suitable for the proposed development, provided measures are implemented during design and construction of the proposed project, to mitigate the potential problems caused by the geologic and seismic conditions identified in this report.

2. A moderate to major earthquake on the Hayward, Calaveras, San Andreas, or one of the other active faults in the Bay Area could produce severe ground shaking at this site.

3. There is no evidence that an active or potentially active fault crosses this site. The potential for ground rupture to occur is therefore considered to be low.

4. There are several layers of potentially liquefiable materials underlying this site. The potential for seismically-induced liquefaction to occur is considered to be moderate to high in those materials. The potentially liquefiable materials are deep enough that it is expected that they will not significantly affect the integrity of well designed and constructed foundations for the arena. There could, however, be some seismically induced areal settlement in the vicinity.

5. The potentially liquefiable soils are much shallower near the river, and structures built in that area could be adversely affected by a loss of shear strength of the underlying soil during a seismic event. Foundations built near the river should be designed to withstand the foregoing eventuality.

6. The potentials for seismically-induced spreading and landsliding to occur is considered to be moderate to high along the unrestrained portions of the river bank.

7. The regional groundwater table at this site is located approximately 47 feet below the existing ground surface. A perched water table is located 17 to 20 feet below the ground surface. The level of both of these groundwater tables will probably vary according to the seasonal rainfall. Records of the regional groundwater level indicate that the groundwater level was higher than currently observed, and was lowered by pumping. The groundwater level has increased recently due to a decline in pumping but could be lowered again if pumping was to increase, or raised if pumping was to cease. Excavations at this site that extend below the perched water table level will encounter groundwater. The amount of water present will vary depending upon the location of the excavation on the site, and the amount of recent precipitation.

8. Structural loads could cause compression of some of the subsurface materials which could result in local settlement.

9. Normal erosion along the Guadalupe River will result in the downcutting and gradual widening of the channel, where it is not confined or controlled. Local slumping along the banks is a normal part of this erosion. Loads imposed by structures built near the top of the bank could accelerate this process.

10. The question of whether the soil at this site is contaminated was to be studied by others. It was not within the authorized scope of work on this project and was not addressed by this study.

11. The suitability of this site for this project relative to the other two sites can be determined by a comparison of the hazards present at each site (see Table I, page 32).

Environmental Impact

12. The construction of an arena at this site would require that the existing buildings be demolished, that significant site grading be done, and that many of the existing utilities be relocated. It should be expected that this type of activity will generate a significant amount of noise at this site, and construction traffic will generate noise on the access streets to this project as well.

13. Construction traffic also poses a potential risk to other vehicles using the streets, will impose significant loads on access streets shortening their life span and necessitating repairs of some of them, and will tend to spread soil into the city streets.

14. Site work will generate dust during the dry summer months. If the construction of this project extends through a winter, the surface runoff water will contain an increased sediment load.

15. The amount of, and impact of noise, traffic, dust, and sediment generated by this project can be minimized by careful planning and construction management.

16. Extensive grading or increased gravity loading along the unsupported river bank on the east edge of the site could cause failure of that slope. Neither of these activities are included as part of the current site development plan.

17. Paving or construction of buildings over most of the site will limit the ability of precipitation to aid in recharging the groundwater supply. It will also limit access for the purpose of pumping groundwater.

TABLE I

COMPARISON OF THE GEOTECHNICAL CONDITIONS THAT WOULD IMPACT THE PROPOSED ARENA, BY SITE

	SITE A	SITE B	SITE C
SITE SUITABLE FOR PROPOSED DEVELOPMENT	YES	YES	YES
SITE SUBJECT TO STRONG GROUND SHAKING	YES	YES	YES
POTENTIAL FOR GROUND RUPTURE TO OCCUR AT THIS SITE	LOW	LOW	LOW
POTENTIALLY LIQUEFIABLE SOILS IDENTIFIED ON THE SITE	YES	YES	YES
POTENTIALLY LIQUEFIABLE SOILS SHOULD BE ADDRESSED DURING DESIGN	NOT REQUIRED	YES	YES
LATERAL SPREADING AND/OR SLUMPING MAY OCCUR ALONG THE STREAM BANKS THAT COULD AFFECT THE ARENA	NO	YES	NO
POTENTIAL FOR LURCH CRACKING TO OCCUR AT THIS SITE	LOW	LOW	LOW TO MODERATE
REGIONAL GROUNDWATER MEASURED WITHIN 20 FEET OF THE GROUND SURFACE	NO	NO	YES
PERCHED GROUNDWATER MEASURED WITHIN 20 FEET OF THE GROUND SURFACE	YES	YES	NO
COMPRESSIBLE SOILS IDENTIFIED WITHIN THE ZONE OF INFLUENCE OF THE ARENA FOUNDATIONS	YES	YES	YES

RECOMMENDATIONS

General

1. The level of groundwater indicates that if the arena is to be constructed with a 15-foot-deep basement, some dewatering may be required during construction. It will be necessary to install a system that will permanently lower the level of the perched groundwater below the basement; to construct a watertight basement; or to install a system of drains and pumps that will handle water that seeps into the basement. If a watertight structure is built, it should be verified that the structural loads exceed the buoyancy forces acting on the structure when the perched groundwater is at its maximum possible level.

2. Potentially liquefiable soils were identified adjacent to the Guadalupe River at approximately the same elevation as the toe of the stream banks. The loss of shear strength in these materials during an earthquake due to liquefaction could cause slope failures. If facilities are to be constructed in this area, it is recommended that they be set back from the top of the bank or that an engineering solution be applied to stabilize the river bank.

3. Some of the loose, granular soils at this site may be expected to densify when subjected to strong ground shaking. This will result in local or areal settlement of the site. Near the river, where there is an open exposed face, some of the saturated granular soils may "flow" out of the slope, causing larger settlements near the river. Structures may be built near the river bank if measures are implemented to stabilize the banks, otherwise, structures should be set back from the top of the bank.

Further Investigation

4. The recommendations in this report regarding site suitability and suitable alternative foundation types are based on the limited site investigation that was described in the body of this report. It is our opinion that this study was comprehensive enough to identify any adverse geotechnical conditions at the site and to determine which types of foundations would be suitable at this site. Should this site be selected for development, further site investigation will be required in order to provide specific foundation design recommendations.

5. Access to the entire site should be arranged prior to the next stage of site investigation.

6. The structural engineer should be consulted to determine if the characteristic period of the site soils needs to be determined, and if a dynamic analysis of the site soils would be warranted.

7. The next phase of this investigation should include a detailed estimate of the expected settlement of the arena. This estimate will require a preliminary layout of the arena columns, and an estimate of their loads. This settlement estimate can be used to determine if a shallow foundation may be an acceptable foundation for the arena.

8. The next phase of this investigation should include a determination of the extent and thickness of the dense sands and gravels underlying this site, to aid in determining whether deep foundations would be suitable for this site.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The conclusions and recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed by the CPT probes or in the exploratory borings. If the actual construction will differ from that planned at the present time, Earth Systems Consultants should be notified to determine whether the conclusions and recommendations enclosed in this report are applicable to the revised project.

2. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes outside of our control. Therefore this report is subject to review by Earth Systems Consultants after a period of three (3) years has elapsed from date of issuance of this report.

3. This report was prepared upon your request for our services, and in accordance with currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

BIBLIOGRAPHY

1. Applied Soil Mechanics, 1987, SOIL INVESTIGATION, HOUSING FOR INDEPENDENT PEOPLE - N. MONTGOMERY & W. JULIAN STREET.
2. Berlogar, Long & Associates, 1978, FAULT INVESTIGATION, MIRASSOU PHASE I, EVERGREEN AREA, SAN JOSE, CALIFORNIA.
3. California Department of Water Resources, 1963, EVALUATION OF GROUND WATER RESOURCES, SOUTH BAY, California Department of Water Resources Bulletin 118-1, Appendix A.
4. California Division of Mines and Geology, 1982, SPECIAL STUDIES ZONES, CALAVERAS RESERVOIR AND SAN JOSE EAST QUADRANGLES.
5. Cooper-Clark and Associates, 1974, GEOTECHNICAL INVESTIGATION, CITY OF SAN JOSE, SPHERE OF INFLUENCE, SAN JOSE, CALIFORNIA.
6. Crittenden, M. D., Jr., 1951, GEOLOGY OF THE SAN JOSE-MOUNT HAMILTON AREA, CALIFORNIA, California Division of Mines and Geology Bulletin 157.
7. Davis, F. F., and C. W. Jennings, 1954, MINES AND MINERAL RESOURCES OF SANTA CLARA COUNTY, CALIFORNIA, California Journal of Mines and Geology, Volume 50, No. 2.
8. Dibblee, T. W., Jr., 1972, PRELIMINARY GEOLOGIC MAP OF THE SAN JOSE EAST QUADRANGLE, U.S. Geologic Survey Open File Report.
9. Earth Systems Consultants, 1984, GEOLOGIC STUDY, MIRASSOU WINERY PROPERTY, SAN JOSE, CALIFORNIA.
10. Helley, E. J., and E. E. Brabb, 1971, GEOLOGIC MAP OF LATE CENOZOIC DEPOSITS, SANTA CLARA COUNTY, CALIFORNIA, U. S. Geological Survey Basic Data Contribution 27.
11. Jennings, C. W., 1975, FAULT MAP OF CALIFORNIA, California Division of Mines and Geology, Geologic Data Map Series, Map 1.
12. Nilsen, T. H., 1972, PRELIMINARY PHOTO INTERPRETATION MAP OF LANDSLIDES AND OTHER SURFICIAL DEPOSITS, ALAMEDA AND SANTA CLARA COUNTIES, CALIFORNIA, U. S. Geological Survey Basic Data Contribution 40.
13. Radbruch-Hall, D. H., 1974, MAP SHOWING RECENTLY ACTIVE BREAKS ALONG THE HAYWARD FAULT ZONE AND THE SOUTHERN PART OF THE CALAVERAS FAULT ZONE, U.S. Geological Survey Miscellaneous Investigation Map I-813.
14. Real, C. R., et al., 1978, EARTHQUAKE EPICENTER MAP OF CALIFORNIA, California Division of Mines and Geology, Map Sheet 39.

BIBLIOGRAPHY

15. Robertson, P. K., and R. G. Campanella, 1986, GUIDELINES FOR USE AND INTERPRETATION OF THE ELECTRONIC CONE PENETRATION TEST, Hogentogler and Company, Gaithersburg, Maryland, 196 pp.

16. Rogers, T. H., and J. W. Williams, 1974, POTENTIAL SEISMIC HAZARDS IN SANTA CLARA COUNTY, CALIFORNIA, California Division of Mines and Geology Special Report 107.

17. San Jose, City of, 1983, FAULT HAZARD MAPS.

18. Santa Clara County Planning Department, 1975, SEISMIC SAFETY PLAN.

19. Seed, H. B., 1974, UNPUBLISHED MAP PREPARED FOR THE SANTA CLARA COUNTY SEISMIC SAFETY ELEMENT - H. B. Seed Data, October 29, 1974.

20. Seed, H. B., and I. M. Idriss, 1982, GROUND MOTIONS AND SOIL LIQUEFACTION DURING EARTHQUAKES, Earthquake Engineering Research Institute, Berkeley, California, 134 pp.

21. Terrasearch, 1974, SOIL INVESTIGATION, PROPOSED OFFICE BUILDING - 300 BLOCK, THE ALAMEDA.

22. United Soil Engineering, 1978, GEOLOGICAL REVIEW OF THE SILVER CREEK FAULT TRACE FOR PROPOSED INDUSTRIAL DEVELOPMENT - FUTURE CHARCOT AVENUE.

23. U. S. Department of Agriculture, 1968, SOILS OF SANTA CLARA COUNTY, CALIFORNIA, Soil Conservation Service Publication.

APPENDIX A

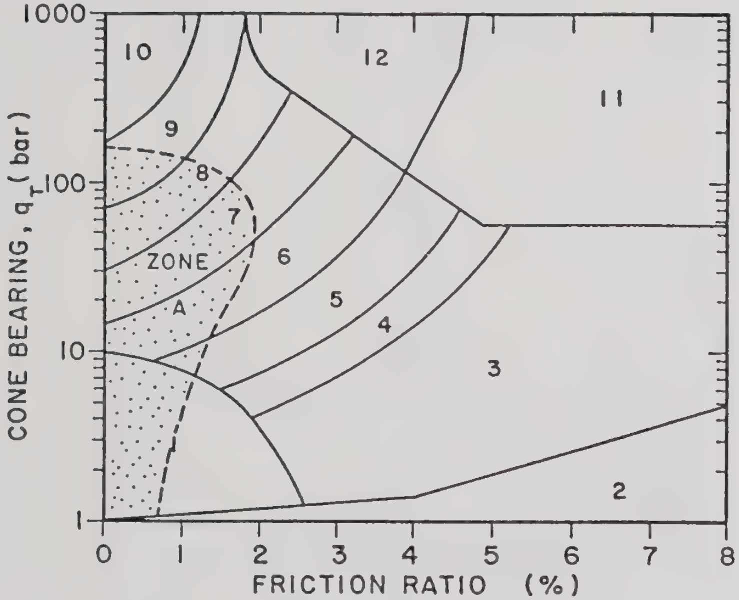
Soil Classification Chart

CPT Data: Tip Resistance, Local Friction, and Friction Ratio

CPT Data: Tip Resistance, Pore Pressure, and Differential Pore Pressure Ratio

CPT Data: Interpreted Soil Stratigraphy

Logs of Borings



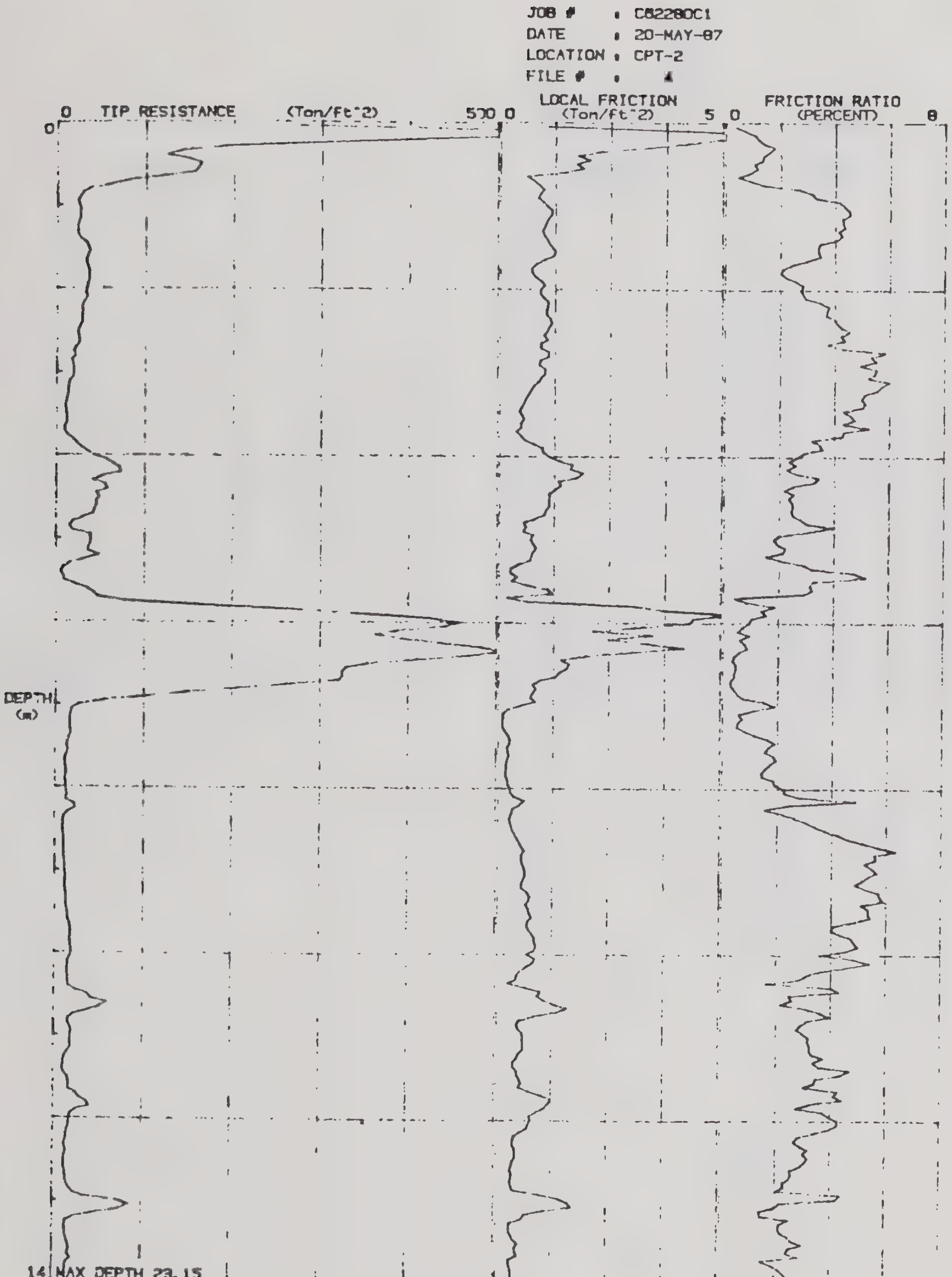
Zone	Soil Behaviour Type
1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained*
12	sand to clayey sand*

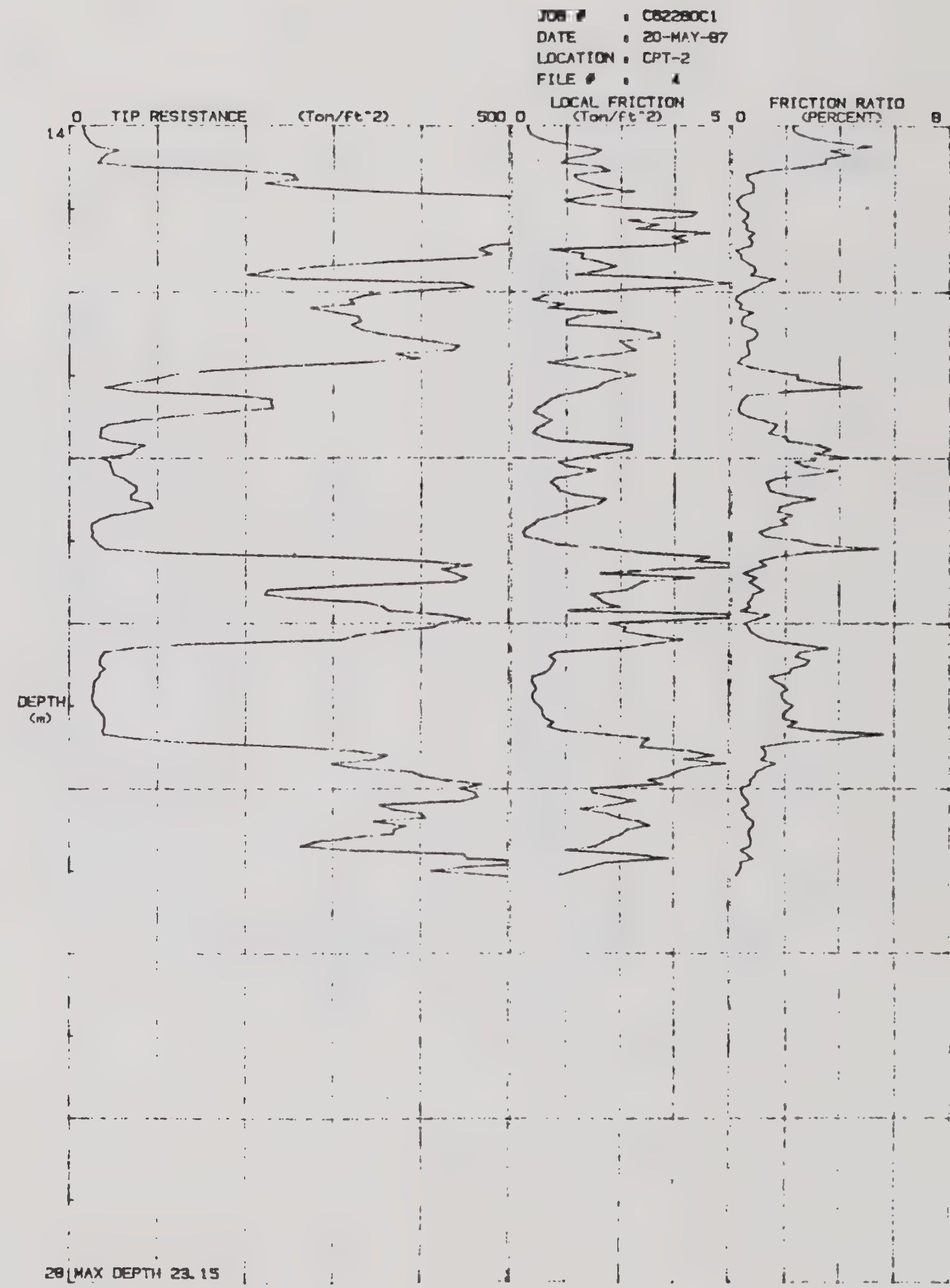
* overconsolidated or cemented.

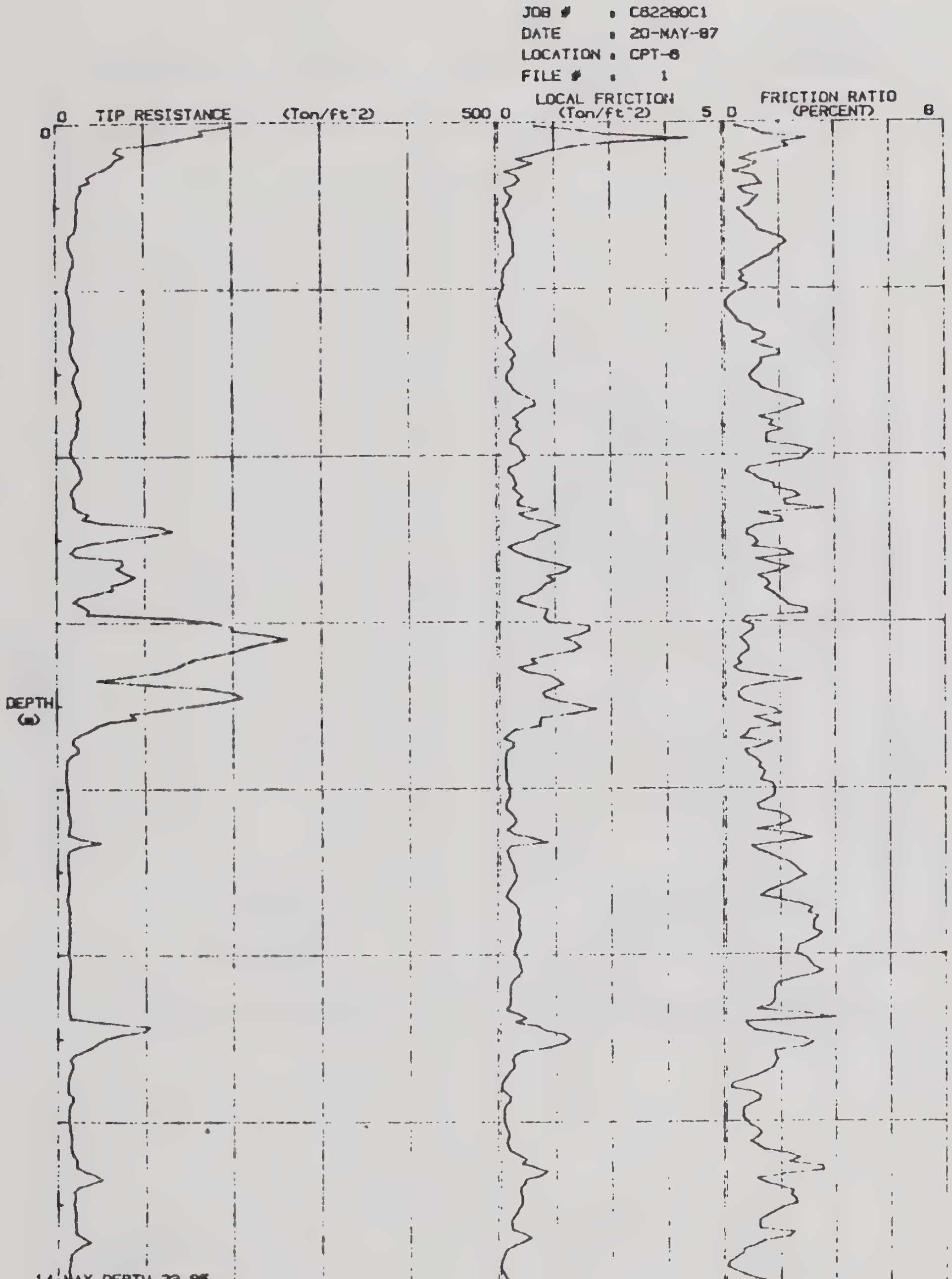
Materials within Zone A are potentially liquefiable.

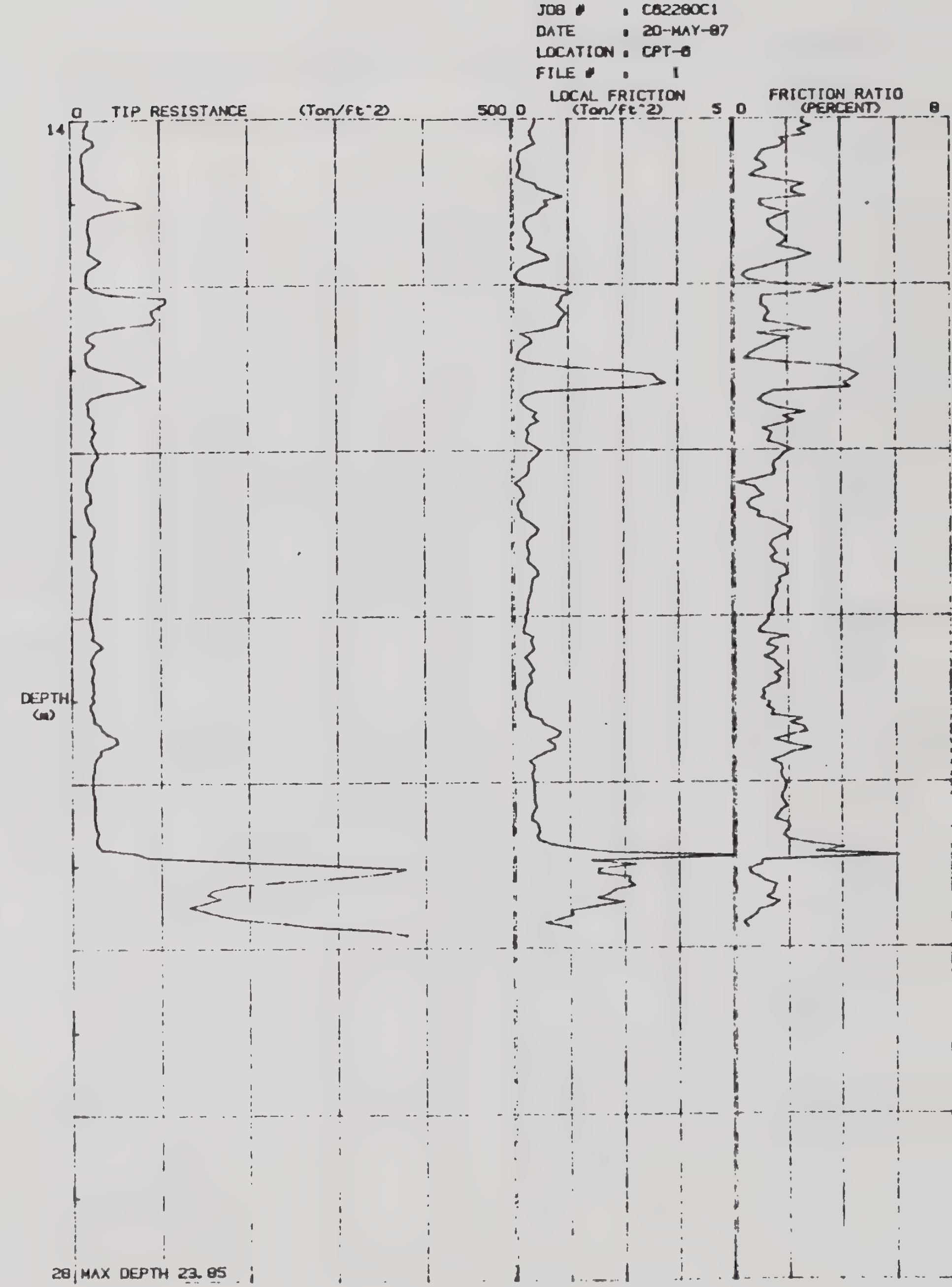
SOIL CLASSIFICATION CHART

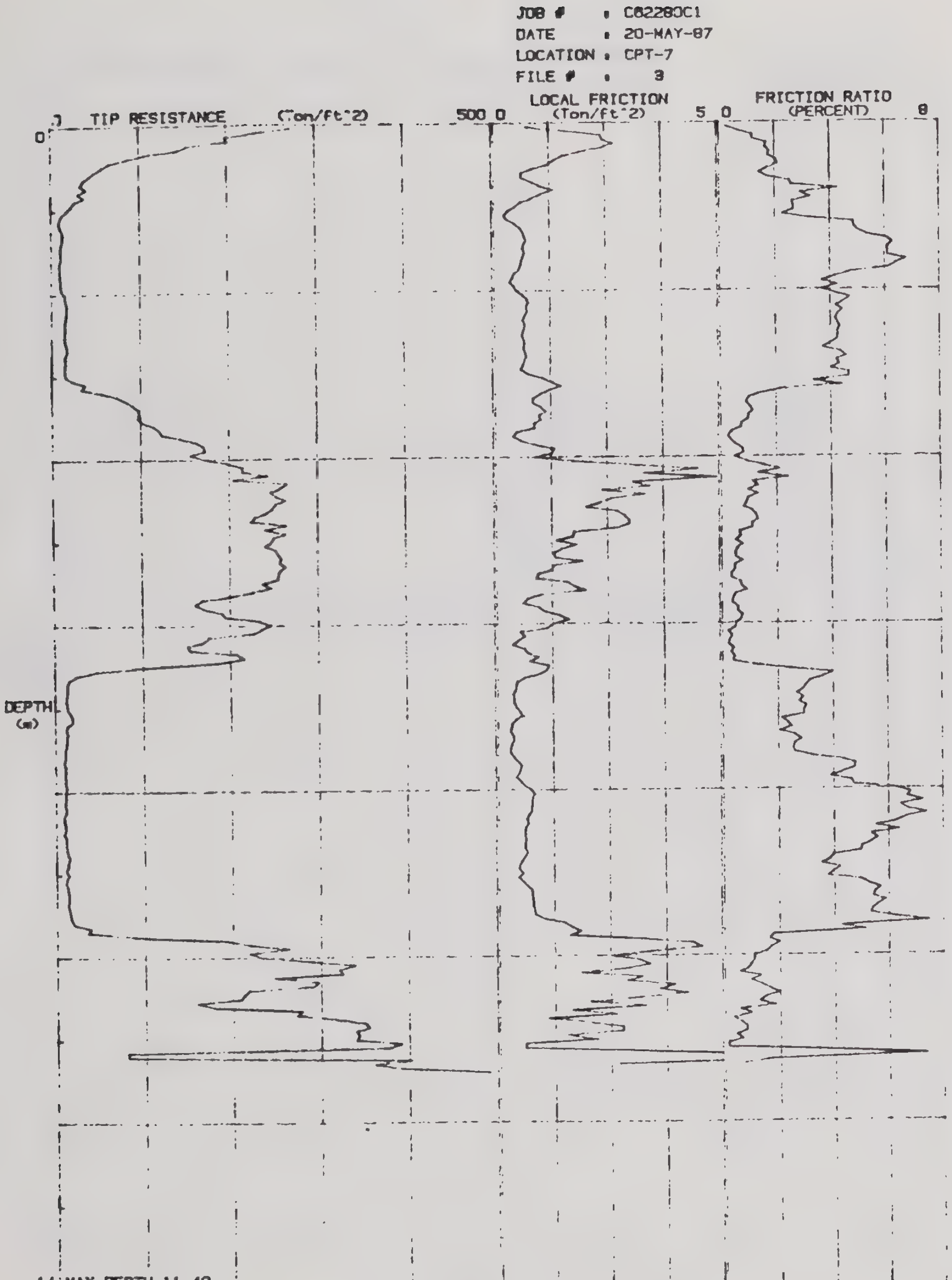
CPT Data: Tip Resistance, Local Friction and Friction Ratio

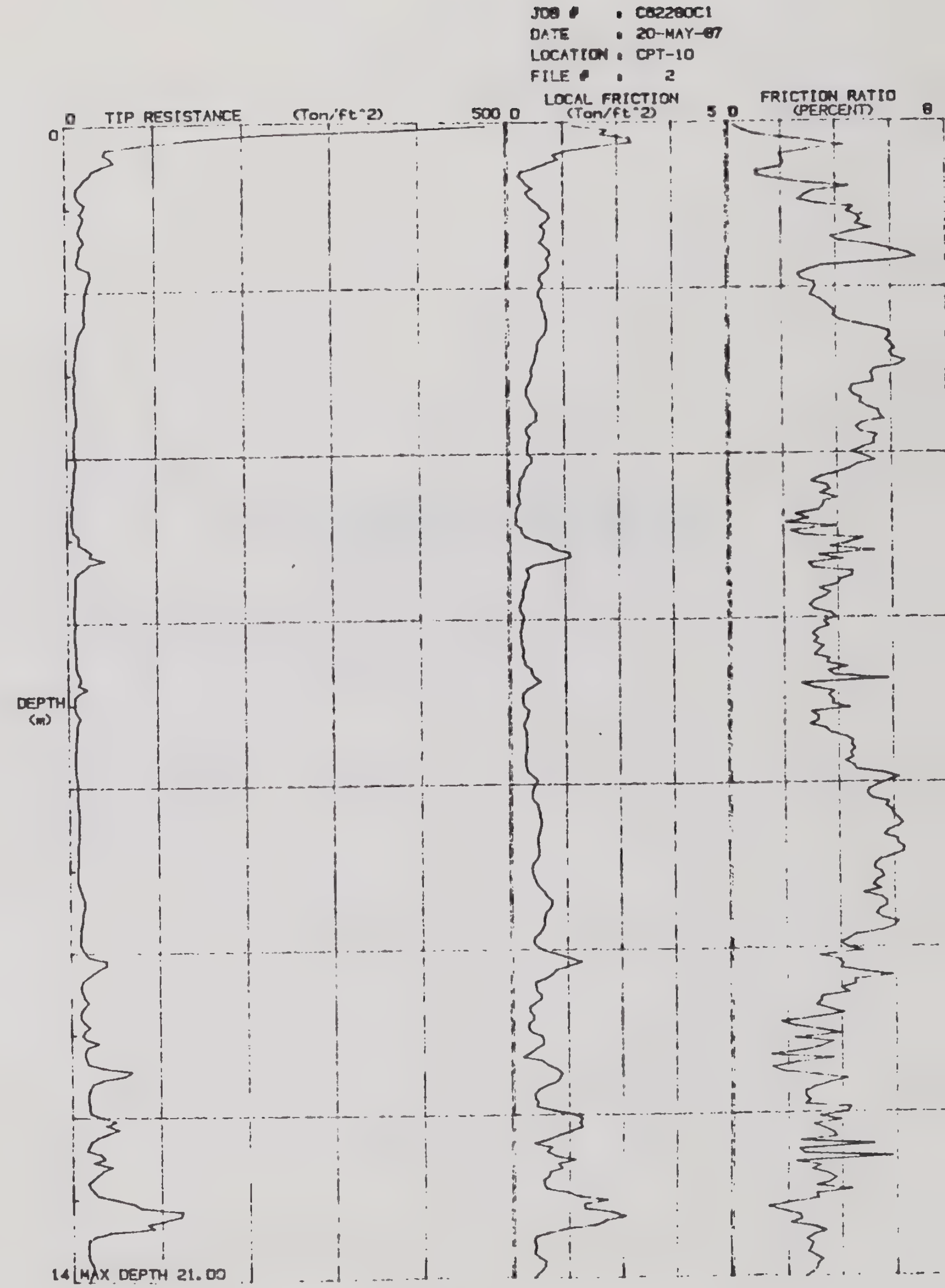

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-2
FILE # : 4
0 TIP RESISTANCE (Ton/Ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 23.15

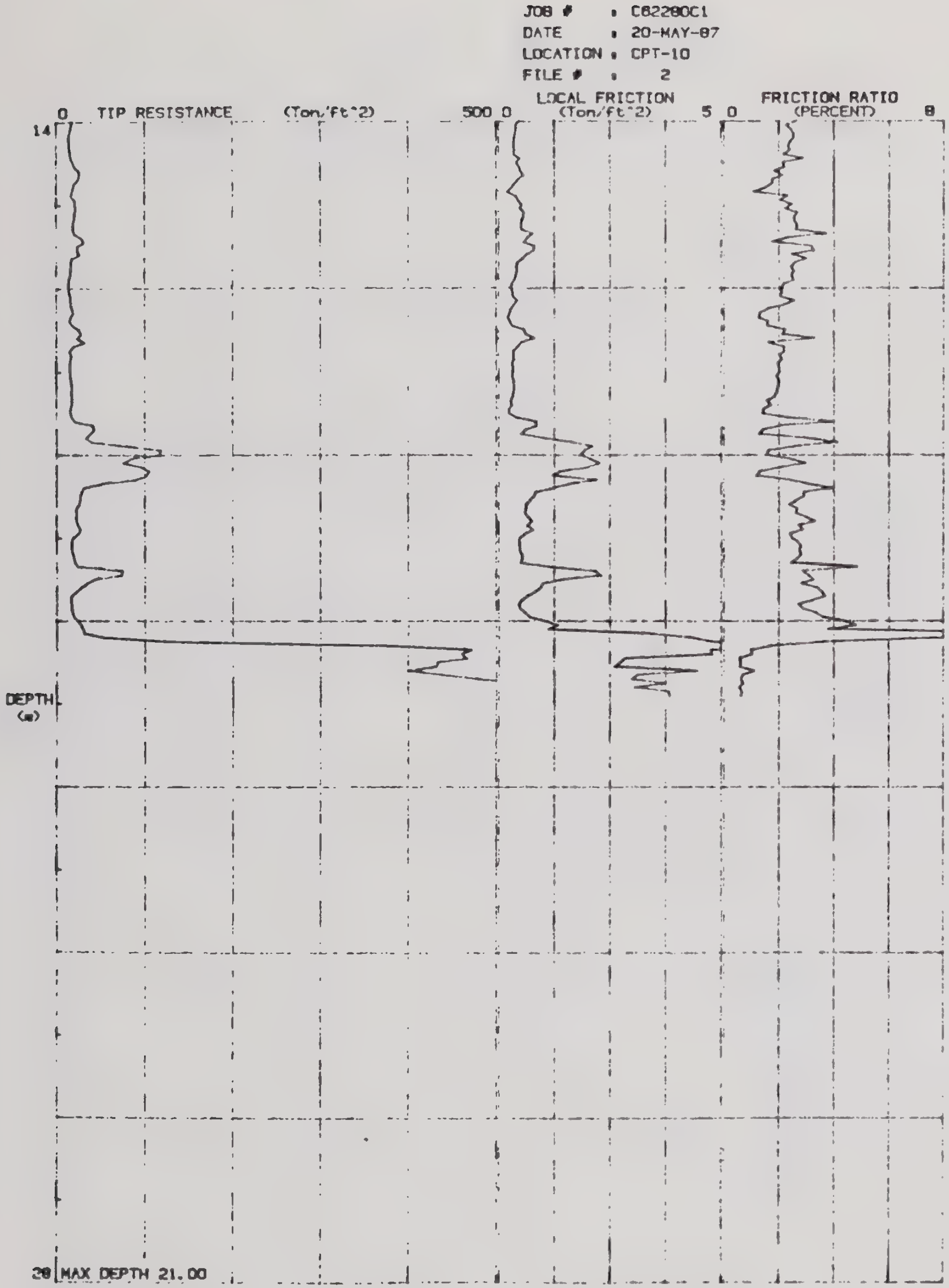

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-2
FILE # : 4
0 TIP RESISTANCE (Ton/Ft^2) 500
0 LOCAL FRICTION (Ton/Ft^2) 5
0 FRICTION RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 23.15


JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-6
FILE # : 1
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
DEPTH (m)
0
14
MAX DEPTH 23.85

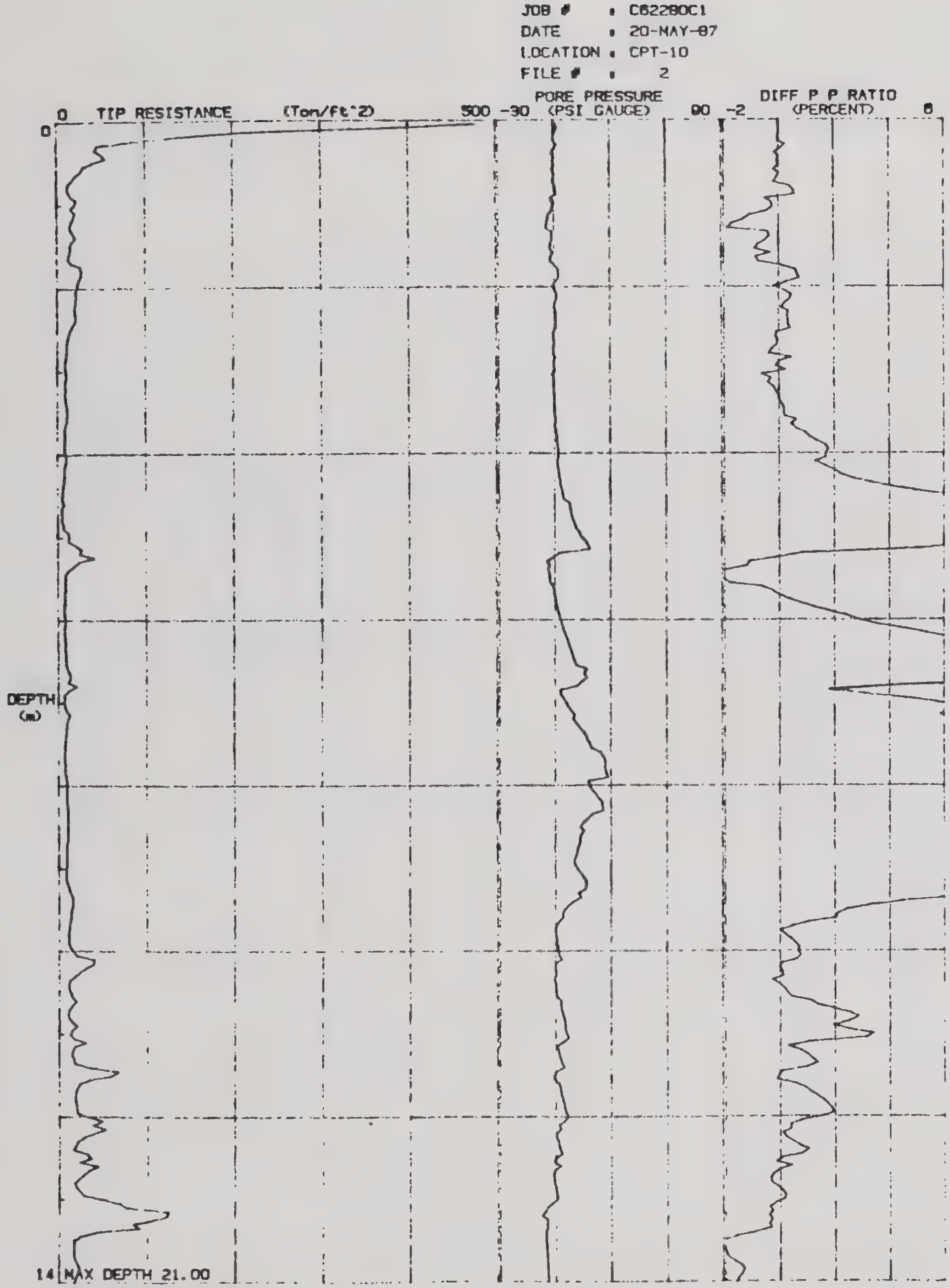

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-6
FILE # : 1
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
DEPTH (m)
14
28
MAX DEPTH 23.85

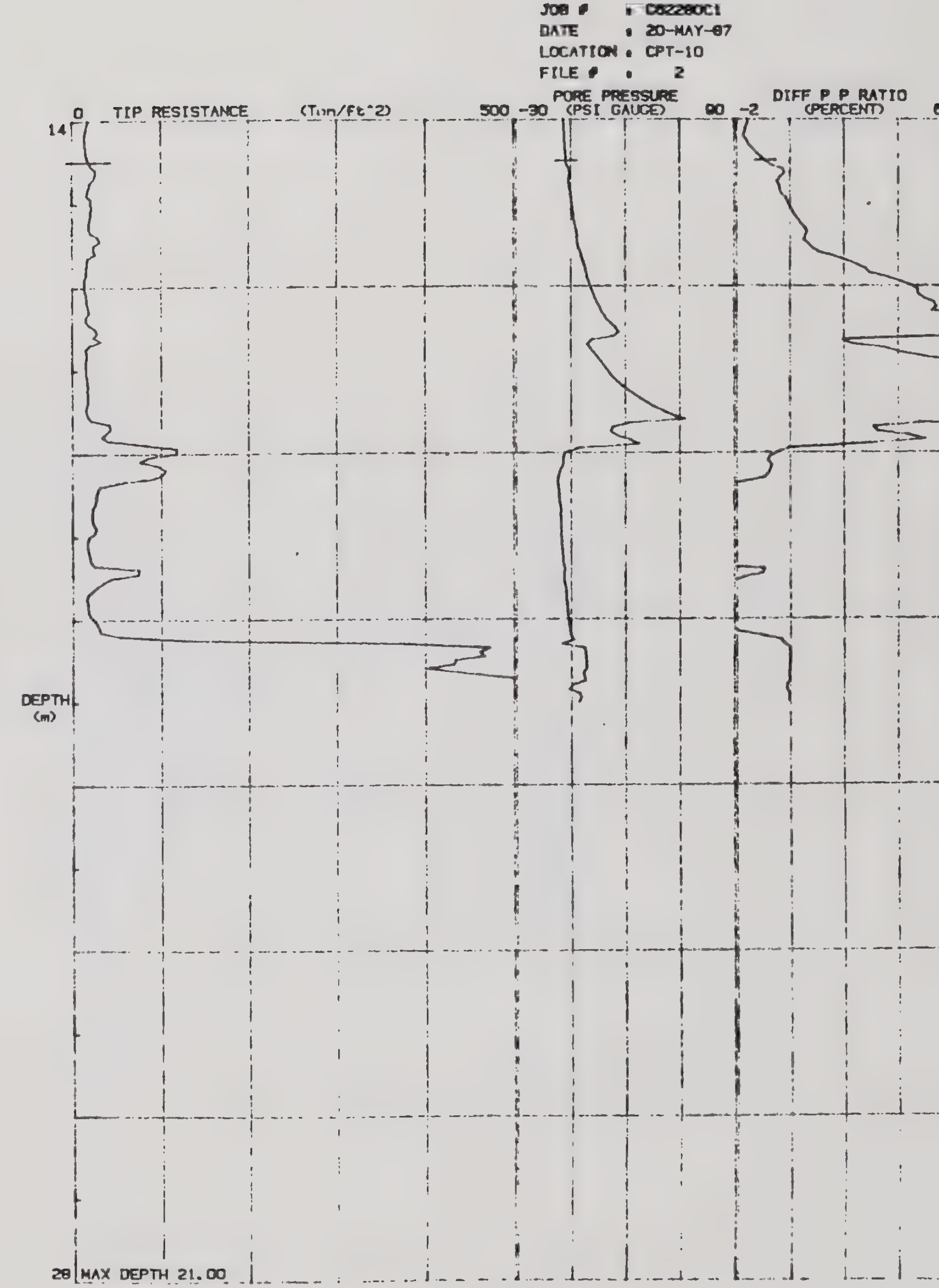

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-7
FILE # : 3
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 11.40

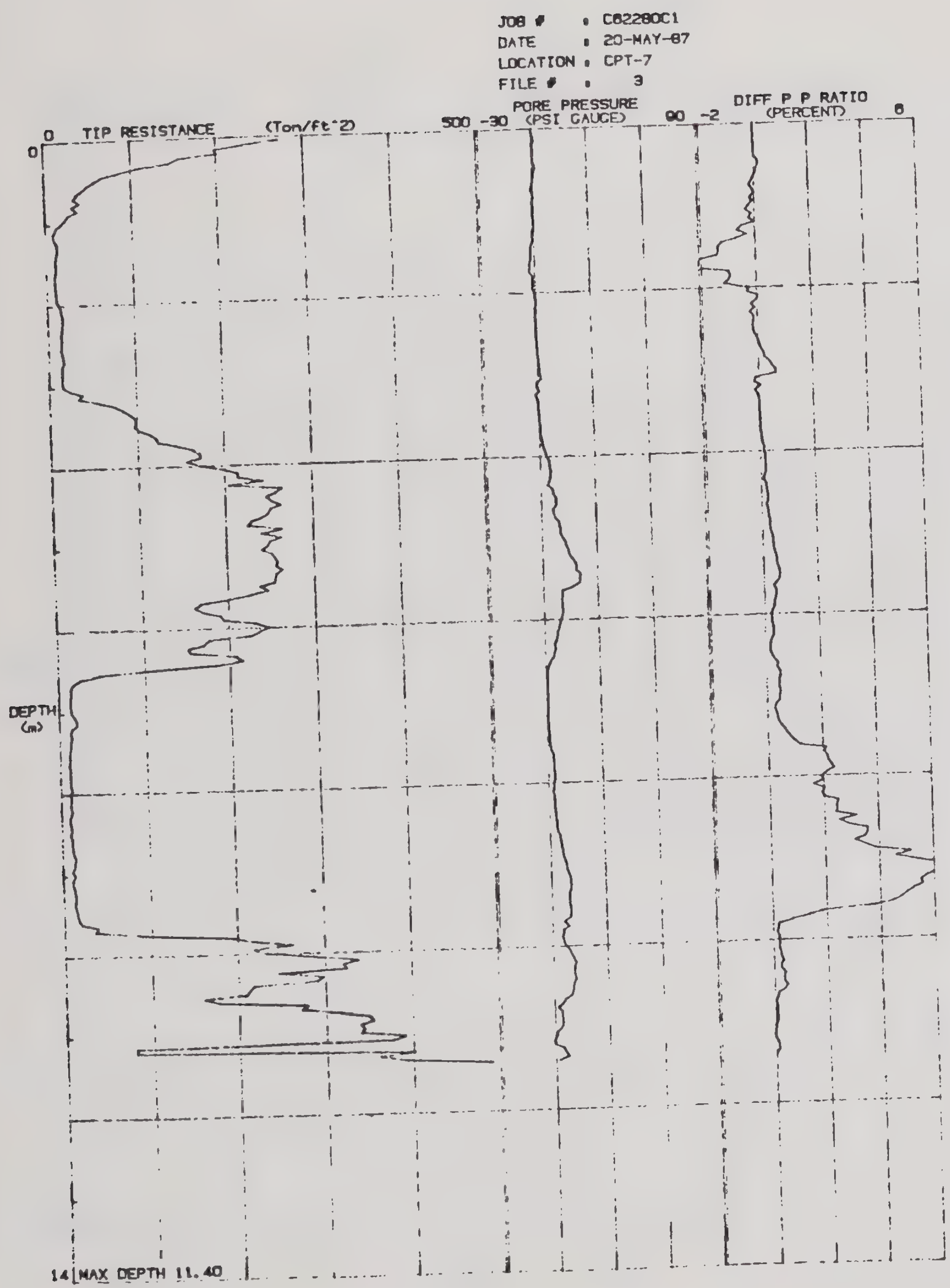

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-10
FILE # : 2
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 21.00



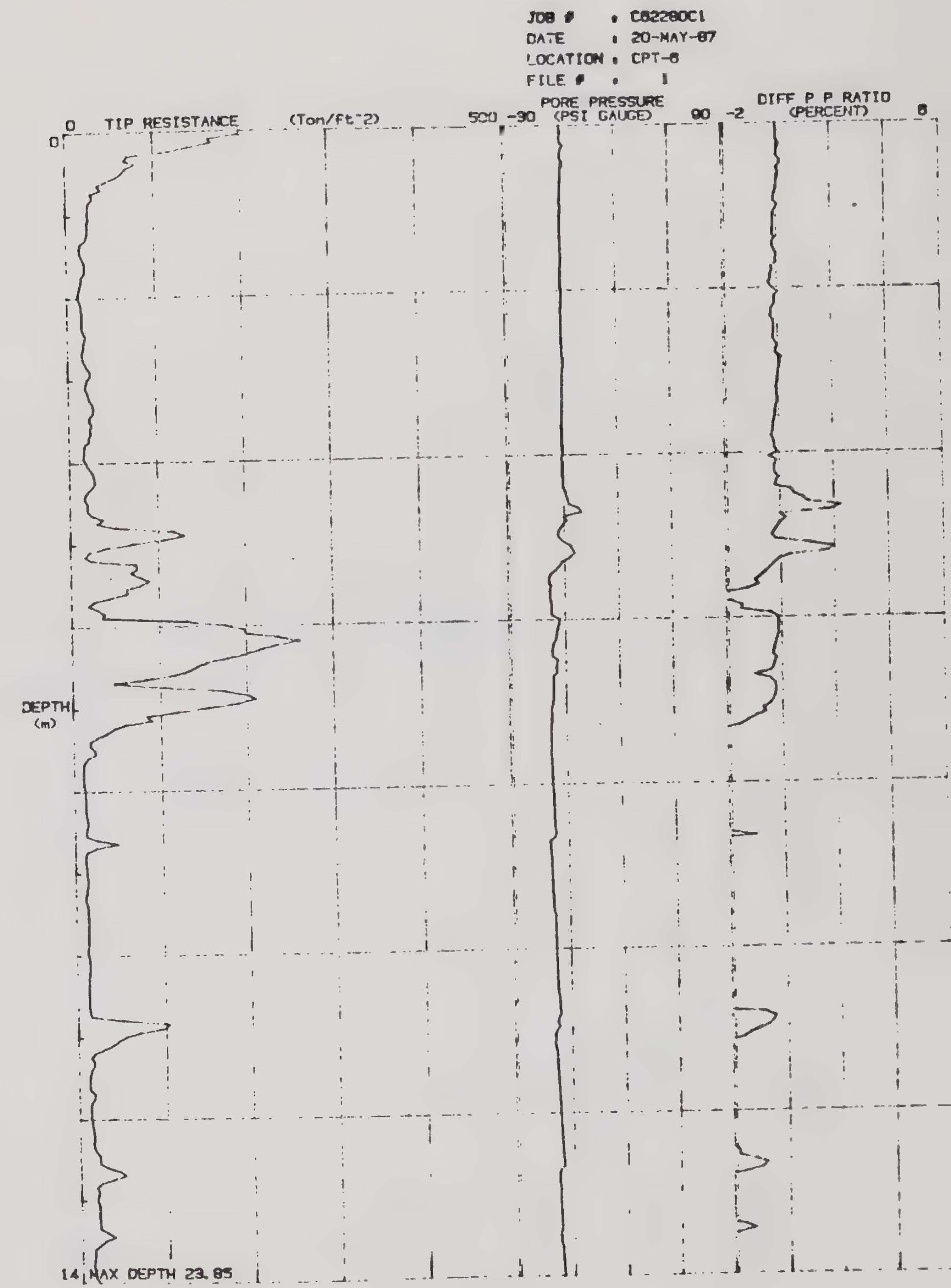
CPT Data: Tip Resistance, Pore Pressure, and Differential Pore Pressure Ratio


JOB # : C62280C1
DATE : 20-MAY-87
LOCATION : CPT-10
FILE # : 2
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 21.00

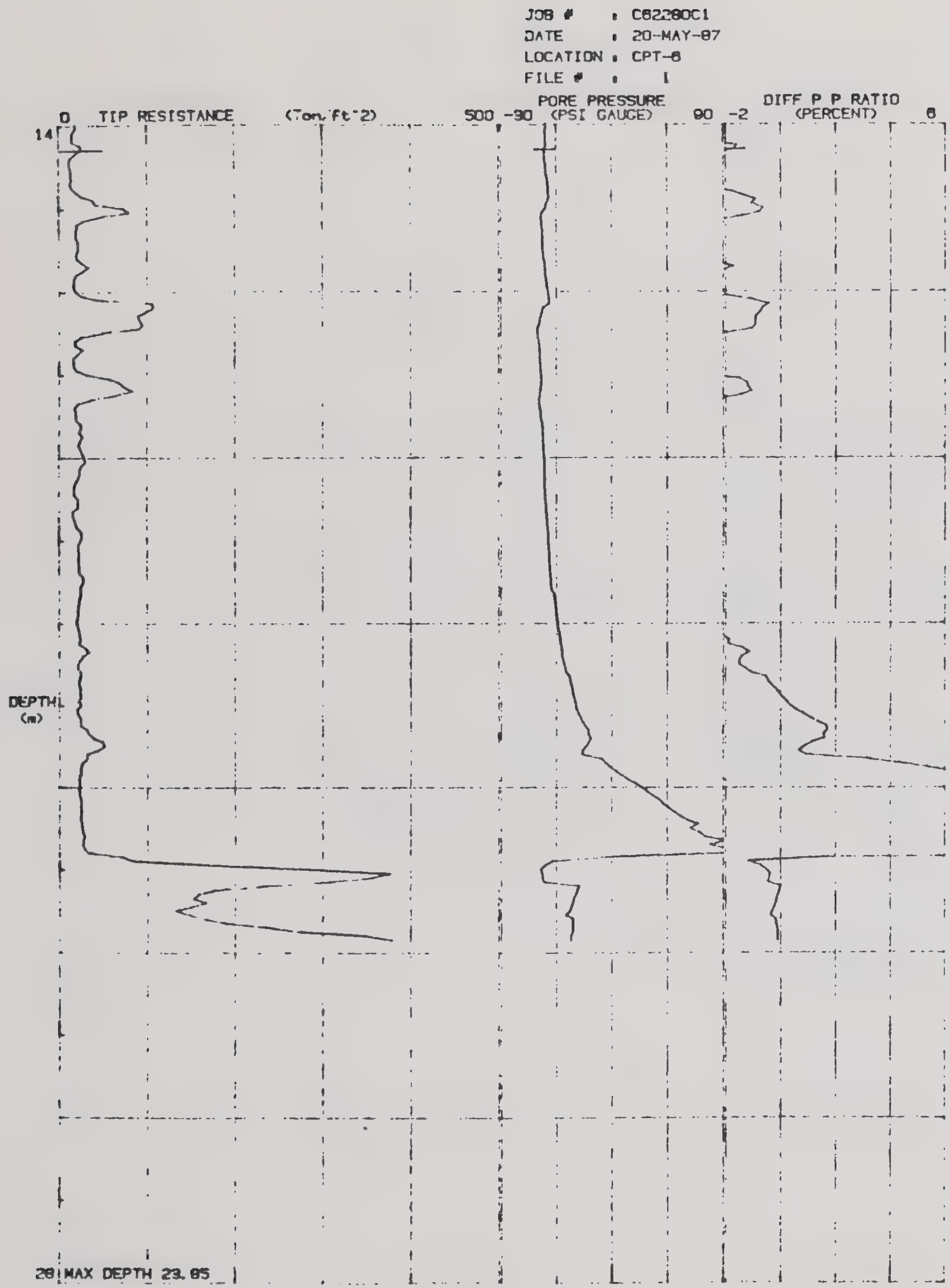

JOB # : C62280C1
DATE : 20-MAY-87
LOCATION : CPT-10
FILE # : 2
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 21.00

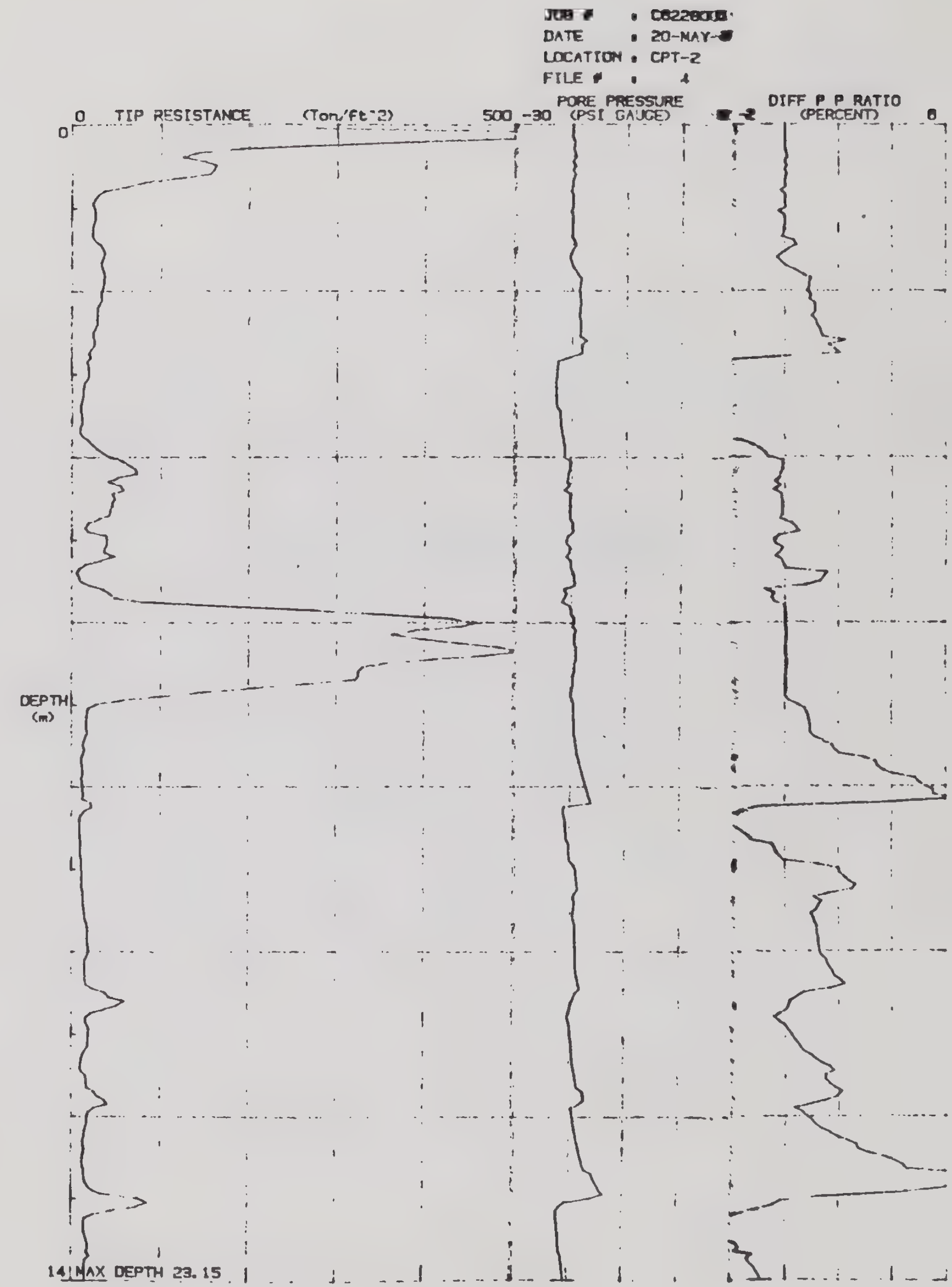

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-7
FILE # : 3
TIP RESISTANCE (Ton/ft^2)
0
500
PORE PRESSURE (PSI GAUGE)
-30
90
DIFF P P RATIO (PERCENT)
-2
8
DEPTH (m)
0
14
MAX DEPTH 11.40

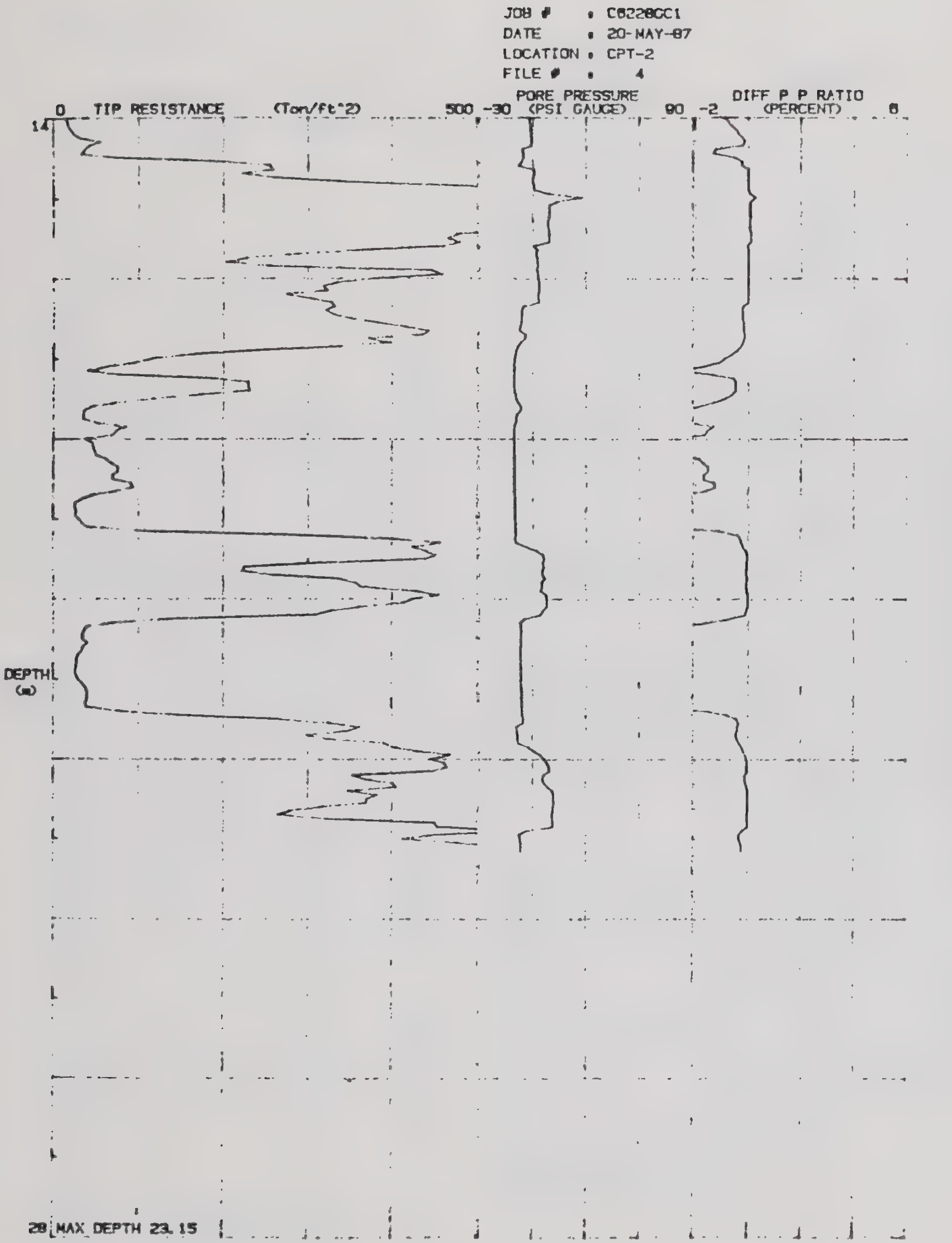
A-11


JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-8
FILE # : 1
TIP RESISTANCE (Ton/ft^2)
0
500
PORE PRESSURE (PSI GAUGE)
-30
90
DIFF P P RATIO (PERCENT)
-2
8
DEPTH (m)
0
14
MAX DEPTH 23.85

A-12


JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-6
FILE # : 1
0 TIP RESISTANCE (Ton/ft^2) 500
-90 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 23.85

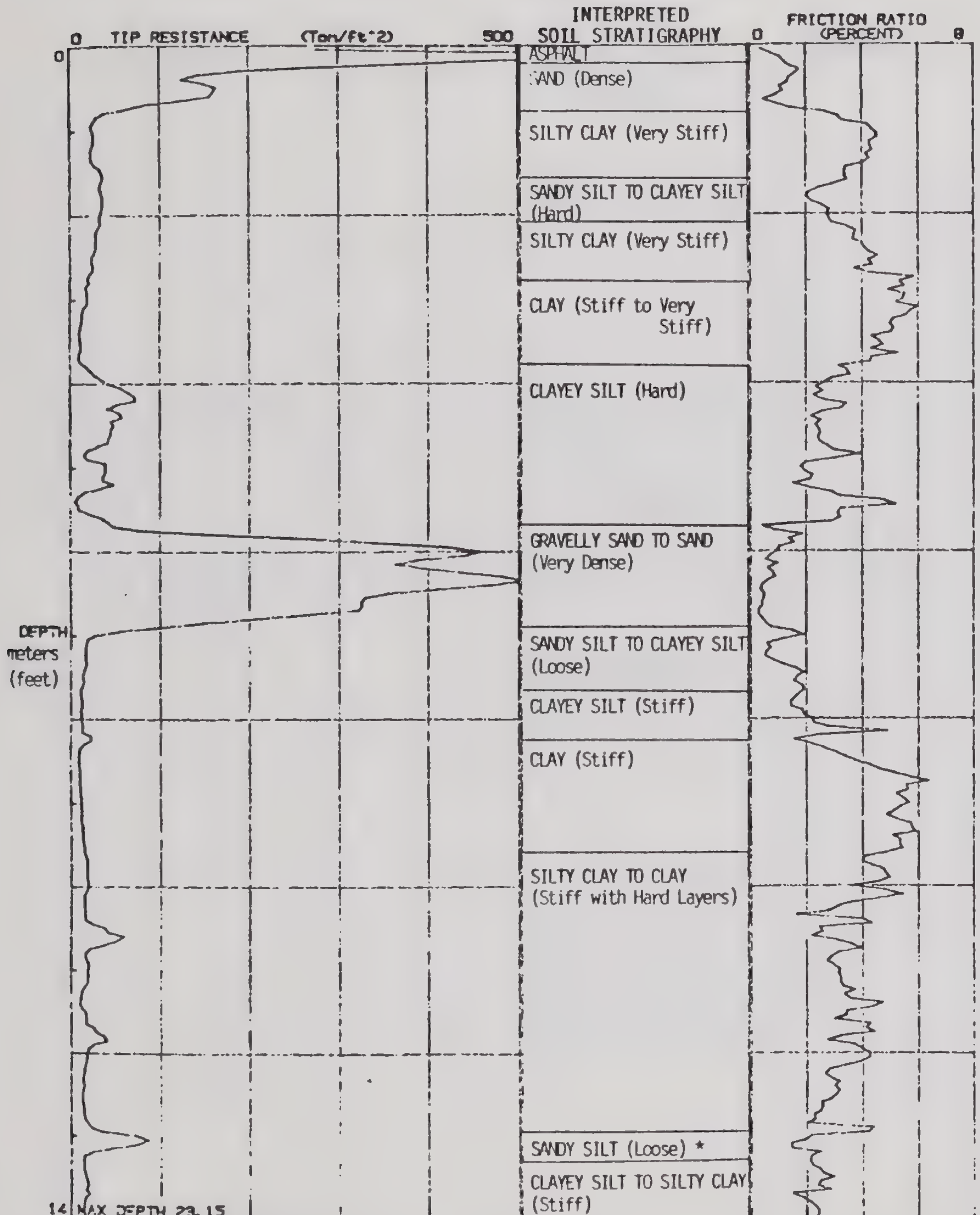

DATE : 20-MAY-
LOCATION : CPT-2
FILE # : 4
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE)
DIFF P P RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 23.15



CPT Data: Interpreted Soil Stratigraphy

File No. C6-2280-C1

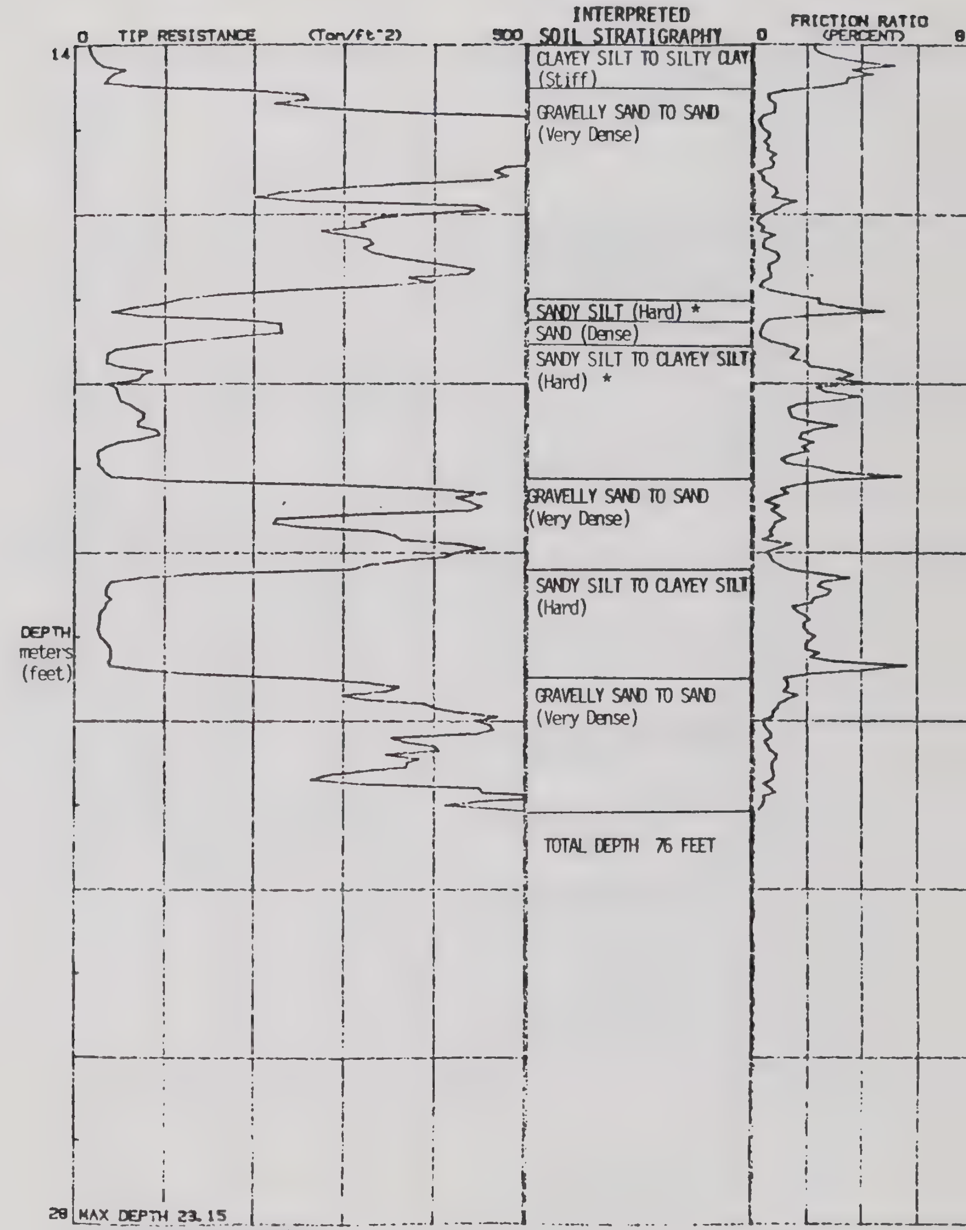
JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-2



* Potentially Liquefiable

File No. C6-2280-C1

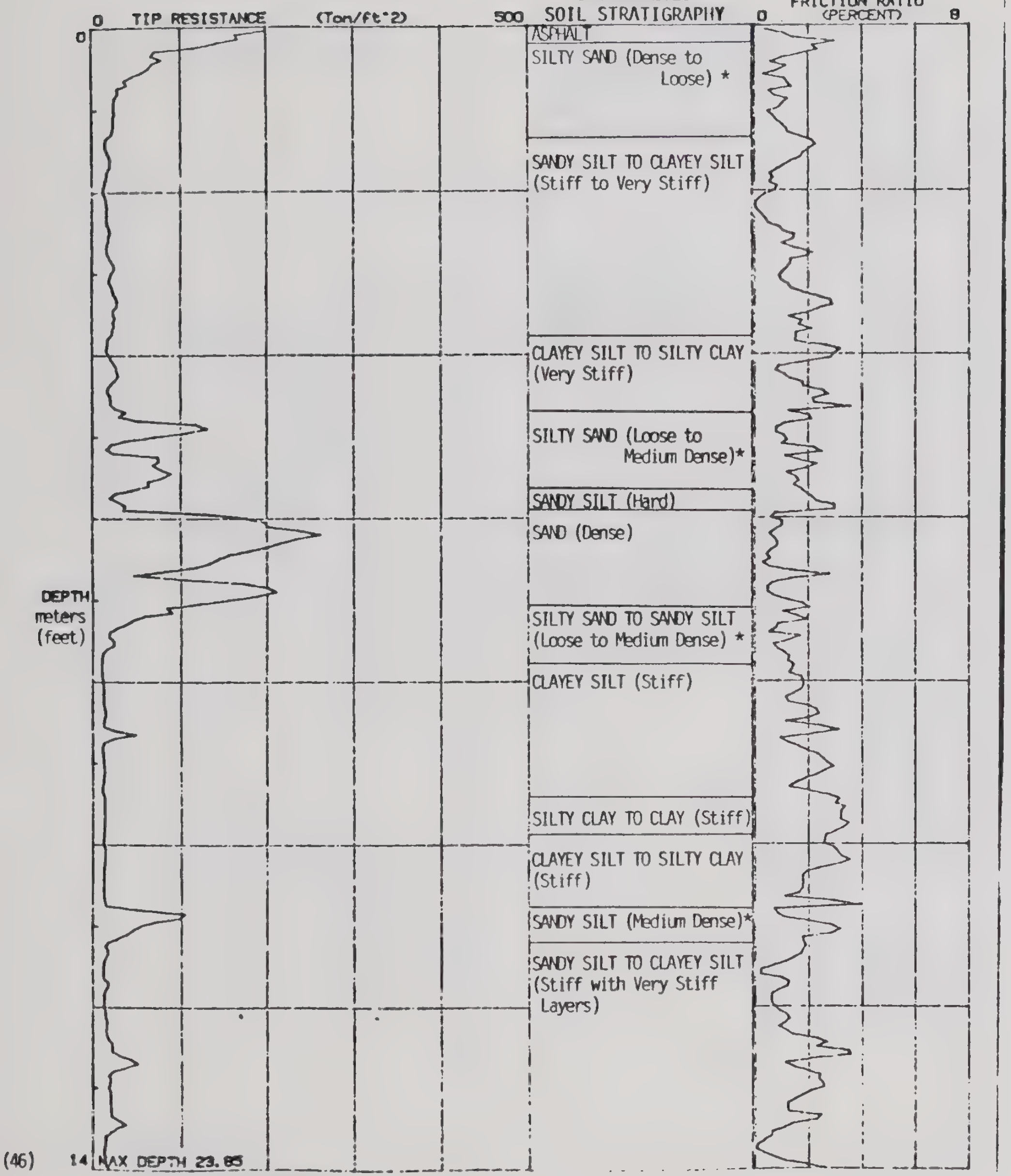
JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-2



* Potentially Liquefiable

File No. C6-2280-C1

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-8

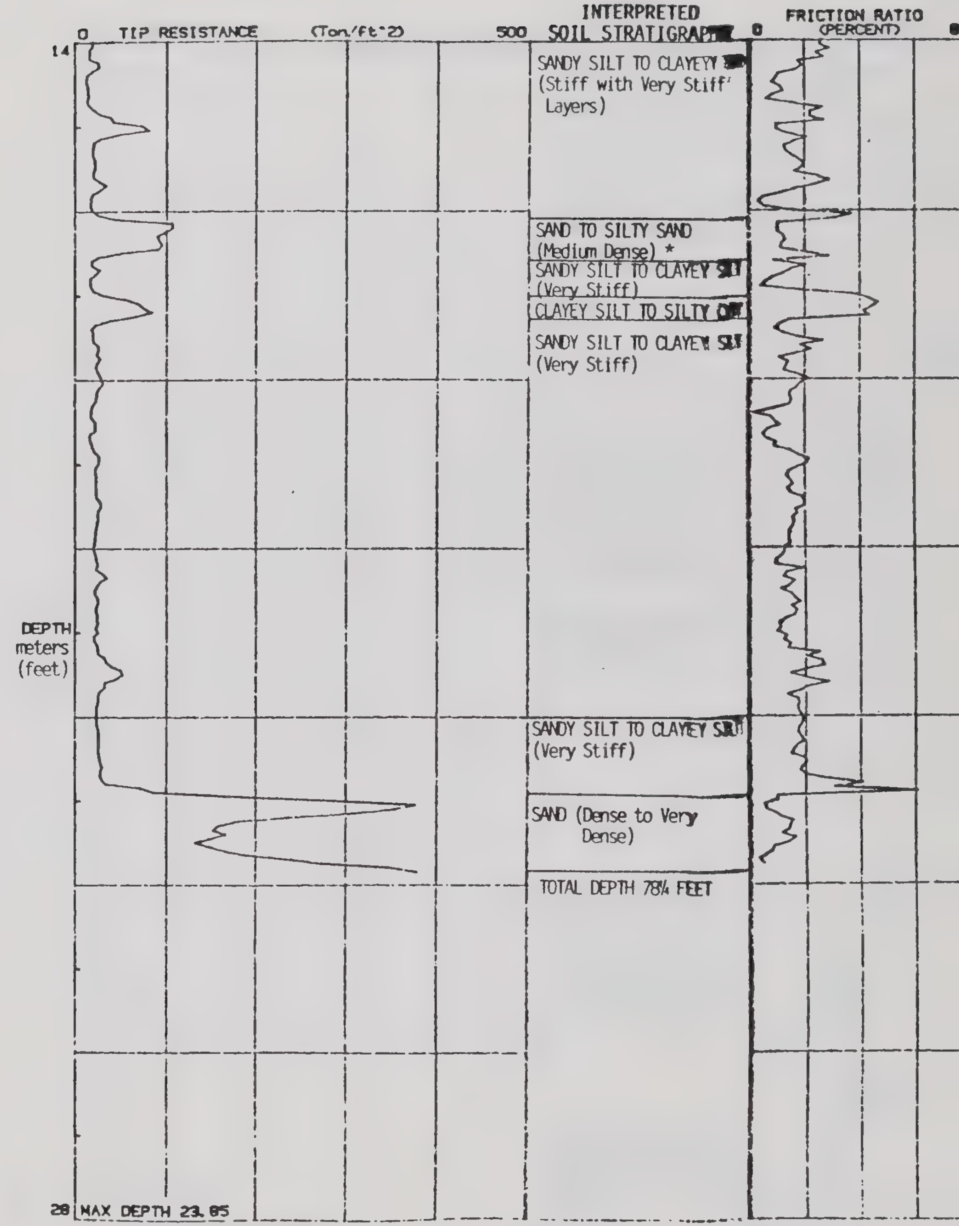


* Potentially Liquefiable

A-18

File No. C6-2280-C1

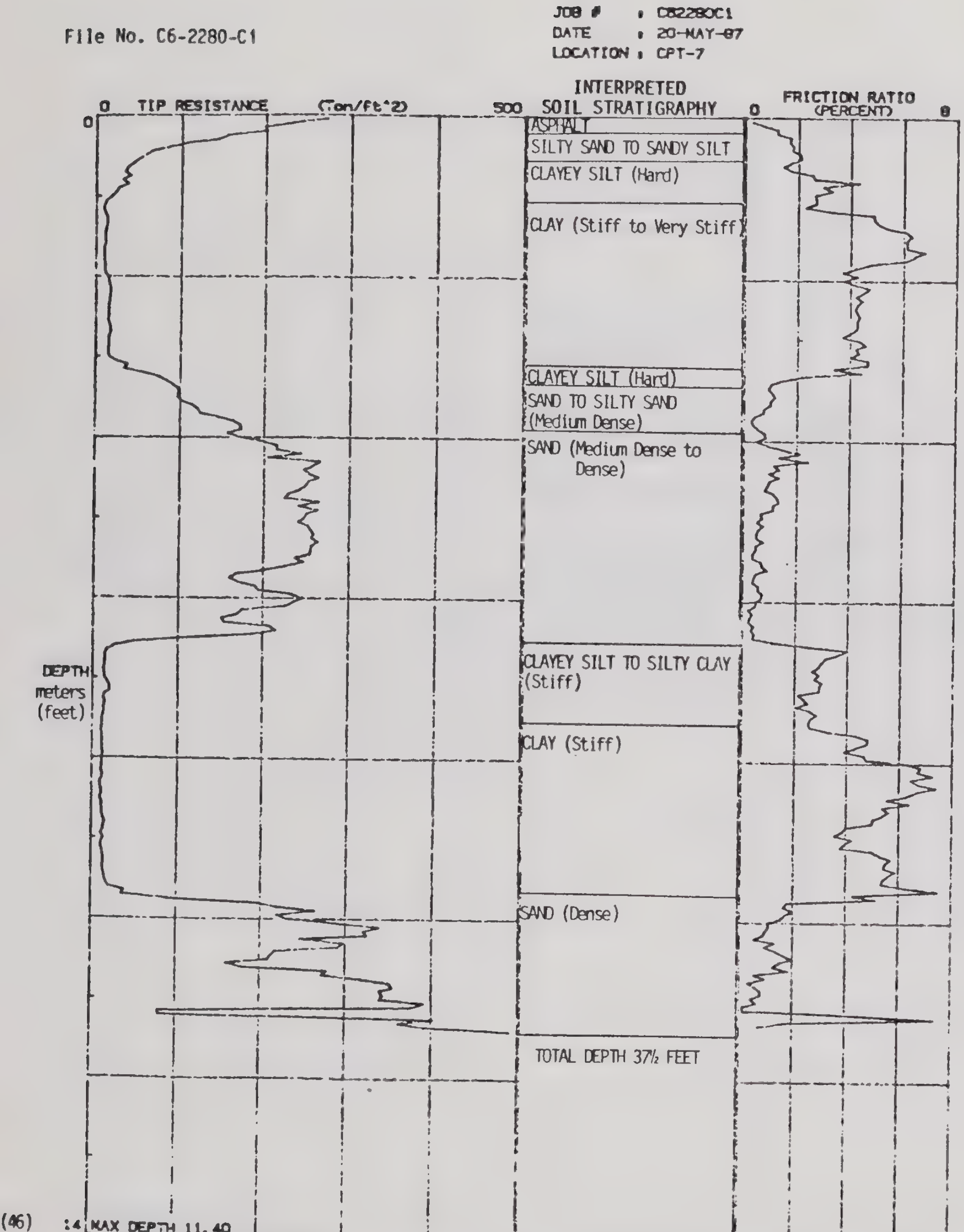
JOB # : C8228
DATE : 20-MA
LOCATION : CPT-



* Potentially Liquefiable

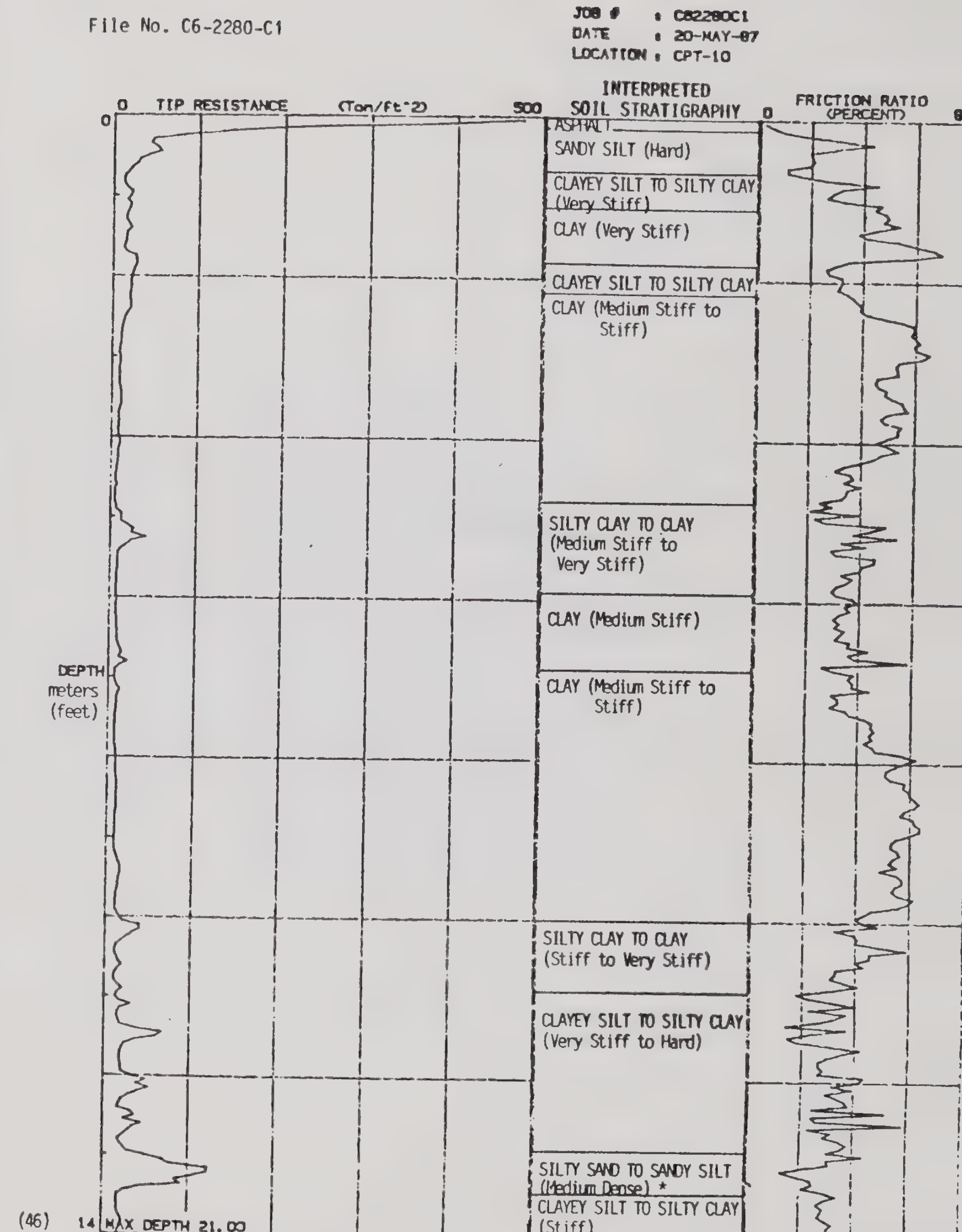
a-19

File No. C6-2280-C1



* Potentially Liquefiable

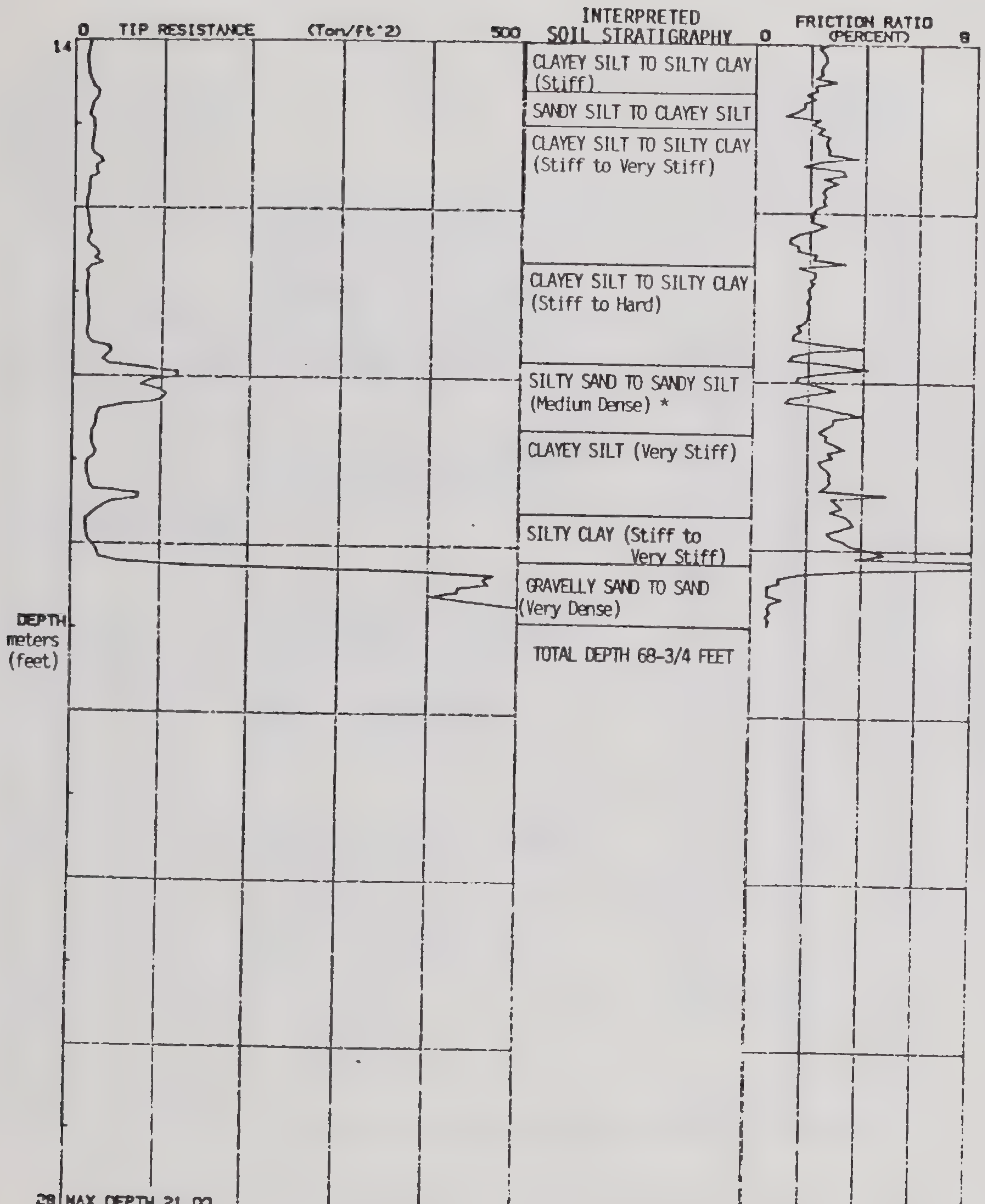
File No. C6-2280-C1



* Potentially Liquefiable

File No. C6-2280-C1

JOB # : C82280C1
DATE : 20-MAY-87
LOCATION : CPT-10



* Potentially Liquefiable

Logs of Borings

Depth in Feet	Sample No	Log & Location of Sample	Penetration Resistance Blows/ft	Description	In-Place Dry Density pcf	In-Place Moisture Content % dry wt
0				**Boring A3**		
				4" Asphalt Concrete over Baserock		
				Fill: Dark grey silty CLAY, damp, stiff (CH)		
5	A3-1		41 (26)	Dark grey silty CLAY with caliche, damp, hard (CH) 4.25	88	31
				Light grey with orange mottling fine sandy CLAY, damp, very stiff (CL) 2.0		
10	A3-2		14 (11)			
	A3-3		42 (26)	Light grey with orange mottling fine sandy CLAY to sandy SILT, damp, stiff (CL) 1.6	99	24
15				Tan silty SAND with fine gravel, damp, dense (SM)		
20	A3-4		15 (9)	Grey to tan silty fine SAND with some clay, wet, loose to medium dense (SM)	117	21
	A3-5		16 (13)	Dark olive grey sandy CLAY to silty CLAY with minor fine gravel, moist, stiff (CL) 1.6	110	18
25				Log continued on next page...		

KEY TO LOGS OF BORINGS

- 3" O.D. Modified California Sampler
- Bulk Sample
- O Pocket Penetrometer Test (in tsf)
- ▽ Groundwater Encountered During Drilling
- (14) Estimated Standard Penetration Test Blow Counts (N Value)

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				Boring A3 - continued			
				-continuing in sandy CLAY			
	A3-6		18 (14)	Olive grey with orange mottling silty CLAY with minor fine gravel, moist to wet, stiff (CL)	O 1.5	90	31
30							
	A3-7		100 (59)	Yellow brown fine to coarse GRAVEL with silty sand matrix, damp, very dense (GW)		-	3
35				-gravel to 3" in diameter			
	N.R.		75/11"				
40				Boring terminated at 39½ feet. Drilled May 28, 1987.			

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				Boring A5			
				4" Asphalt Concrete over 18" Baserock, slightly damp, dense			
	A5-1		9 (7)	Fill: Mottled tan and dark brown fine sandy CLAY with gravel, damp, very stiff (CL)	O 2.75	85	26
5	A5-2			Black silty CLAY, moist, very stiff (CH)		-	27
	A5-3		20 (15)	Light grey with orange mottling sandy CLAY, damp, very stiff (CL)	O 2.75	101	23
10							
	A5-4		21 (13)	Tan silty fine SAND, damp, medium dense (SM)		94	19
15							
	A5-5		32 (19)	Tan to brown with orange and red mottling, fine to coarse GRAVEL with silty sand matrix, gravels are subround up to 2" diameter, medium dense (GW-GM)	∇	-	5
20							
	A5-6			Grey silty CLAY, very moist, medium stiff (CH) (Old Bay Mud)	O 0.9	99	26
25				Log continued on next page...			

Depth in Feet	Sample No	Log & Location of Sample	Penetration Resistance Blows/ft	Description	In-Place: Dry Density pcf	In-Place: Moisture Content % dry wt
				Boring A5 - continued		
25				Orange and grey mottled silty CLAY with fine sand, moist, stiff (CH)		
	A5-7		28 (20)	1.75	90	34
30						
				Sandy CLAY 1.3		
	A5-8		56 (35)		106	21
35				Tan and grey mottled dense GRAVEL, sandy fine to coarse (GW)		
	A5-9		50/5"		-	2
40				Boring terminated at 38½ feet. Drilled May 28, 1987.		

Depth in Feet	Sample No	Log & Location of Sample	Penetration Resistance Blows/ft	Description	In-Place: Dry Density pcf	In-Place: Moisture Content % dry wt
				Boring A6		
0				Asphalt Concrete		
				Fill: Orange brown well-graded silty to sandy GRAVEL with sandy clay matrix, damp, dense (GC)		
5	A6-1		9 (7)	Dark brown sandy SILT, damp, medium stiff (ML)		
10	A6-2		15 (9)	Grey brown silty fine SAND with abundant subrounded gravel and debris (brick fragments) damp, loose (SM) -glass fragments	90	9
	A6-3		29 (21)	Sandy SILT to silty SAND with fine gravel with organics (ML-SM)	113	18
				Sandy SILT with clay, damp, medium dense (ML)		
15				Orange silty fine SAND with trace clay, saturated, medium dense (SM)		
	A6-4		31 (18)		101	23
20				Olive grey sandy CLAY with remnant root lines, very moist, stiff (CL)		
	A6-5		21 (16)	Grey tan fine sandy SILT to silty SAND, saturated, medium dense (ML-SM) 1.5	99	28
				Grey silty CLAY, very moist, stiff (CH)		
25						

Log continued on next page...

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				Boring A6 - continued			
				-continuing in silty CLAY			
30	A6-6		17 (13)	Grey silty CLAY with organic odor, very moist, stiff (CL)	1.1		
35	A6-7		20 (15)	Medium grey with orange mottling, slightly clayey SILT, moist, stiff (CL)	1.5	88	33
40	A6-8		20 (15)	Grey with orange mottling silty CLAY with trace organics, moist, stiff (CH)	1.0	97	26
				Boring terminated at 40 feet. Drilled May 28, 1987.			

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				Boring A9			
				4" Asphalt Concrete over 7" Baserock			
				Fill: Brown sandy CLAY, moist, stiff (CL)			
5	A9-1		32 (22)	Black silty CLAY, moist, very stiff (CL-CH)	3.25	85	30
				Light grey silty CLAY with caliche			
10	A9-2		18 (14)	Light olive grey with orange mottling, clayey SILT, moist, stiff (CL)	2.25		
15	A9-3		15 (12)		1.25		
20	A9-4		16 (13)	Dark grey with brown fine sandy CLAY, moist, medium stiff (CL)	0.75	107	21
25	A9-5		26 (19)	Olive grey to yellow brown sandy CLAY with ferrous stains, minor decomposed organcis, very moist, stiff (CH)	1.5	98	23

Log continued on next page...

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring A9 - continued		
25				-continuing in sandy CLAY		
30	A9-6		19 (14)	Blue grey silty CLAY with sand, moist, stiff (CH) 1.75		
35	A9-7		50/6"	Yellow brown well-graded GRAVEL 1/4" to 2" in diameter with well-graded sand matrix, damp to moist, very dense (GW) -increasing moisture		
	A9-8		75/9"		121	5
40				Boring terminated at 39 feet. No groundwater encountered during drilling. Drilled May 29, 1987.		

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring A11		
0				Fill: GRAVEL with silty sand matrix, damp, medium dense (GW)		
5	A11-1 B		48 (30)	Dark grey silty CLAY, moist, very stiff (CL-CH) 3.75	91	9
10	A11-2		28 (20)	Light olive grey with orange mottling silty CLAY with fine sand, moist, very stiff (CL) 3.5	102	20
15	A11-3		31 (22)	Dark greyish brown fine sandy CLAY, moist, stiff (CL) 2.0	105	20
20	A11-4		22 (17)	1.5 -minor seams of wet clayey sand and minor decayed rootlets	102	22
25	A11-5		22 (17)	Dark grey silty CLAY, moist, stiff (CH) 1.6 / 1.75	99	25

Log continued on next page...

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring A11 - continued		
25				Light grey with orange mottling silty CLAY, moist, stiff (CH)		
30	A11-6		17 (13)	Light grey with orange mottling sandy CLAY to silty CLAY with fine sand, moist, hard (CH-CL) 4.5 / 1.75 O	96	28
35	A11-7		41 (26)	Fine GRAVEL with sandy silt matrix, very moist, dense (GM)	118	11
				-coarser gravel up to 2½" diameter		
	A11-8		82/11"	Well-graded GRAVEL with sand matrix, moist, very dense (GW)	-	5
40				Boring terminated at 39½ feet. No groundwater encountered during drilling. Drilled May 29, 1987.		

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring A12		
0				2" Asphalt Concrete over 6" Baserock		
				Brown sandy SILT, damp, very stiff (ML)		
5	A12-1		31 (22)	Dark grey silty CLAY, damp to moist, very stiff (CH) O 3.0	89	30
10	A12-2		24 (19)	Light grey with orange mottling, silty CLAY with fine sand, damp, very stiff (CH) O 3.25	104	23
15	A12-3		22 (17)	-grading sandier Tan fine sandy CLAY to sandy SILT, moist (CL-ML) -grading between sandy CLAY and sandy SILT	95	29
20	A12-4		9 (7)	Grey fine sandy CLAY, very moist, soft to medium stiff (CL) O 0.5	96	25
25	A12-5		21 (16)	Medium olive grey sandy CLAY, very moist, stiff (CL) 1.0 O 1.75	-	22
				Log continued on next page...		

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring A12 - continued		
25				Dark grey silty CLAY, moist, stiff (CH)		
				Light olive grey with orange mottling, silty CLAY with fine sand, moist, stiff (CL)		
30	A12-6		23 (18)	O 1.5	95	26
35	A12-7		39 (24)	Blue grey sandy SILT to sandy CLAY, with very fine to fine sand, clay content - 15%, moist, very stiff (CL) O 2.25	105	21
	A12-8		29 (17)	Blue grey clayey fine SAND to sandy CLAY, with minor decayed rootlets, moist, medium dense (CL)	103	22
40				Boring terminated at 40 feet. No groundwater encountered during drilling. Drilled May 29, 1987.		

APPENDIX B

Summary of Laboratory Test Results

Direct Shear Test Results

Grain Size Analysis Results

Consolidation Test Results

Table 1

Summary of Moisture, Density, Swell and Direct Shear Testing

		In-Place Conditions		Swell Tests			Direct Shear Testing	
Sample Number	Depth (Ft.)	Dry Density pcf	Moisture Content % Dry Wt	Swell Index (A)	% Swell	Moisture Increase % (B)	Angle Of Internal Friction Degrees	Unit Cohesion psf
A3-1	4	88	31					
A3-2	9							
A3-3	14	99	24					
A3-4	19	117	21	See Grain Size Analysis				
A3-5	24	110	18					
A3-6	29	90	31					
A3-7	34	-	3					
A5-1	4	85	26					
A5-2	6	-	27					
A5-3	9	101	23					
A5-4	14	94	19				33	180
A5-5	19	-	5					
A5-6	24	99	26					
A5-7	29	90	34	See Consolidation Test				
A5-8	34	106	21					
A5-9	38	-	2					
A6-1	5							
A6-2	9	90	9					
A6-3	13	113	18					
A6-4	18	101	23					
A6-5	23	99	28	See Grain Size Analysis				
A6-6	29							
A6-7	34	88	33					
A6-8	39	97	26					
A9-1	4	85	30					
A9-2	9							
A9-3	14	-	10					
A9-4	19	107	21	See Consolidation Test				
A9-4				See Grain Size Analysis				
A9-5	24	98	23					
A9-6	29							
A9-7	34							
A9-8	39	121	5					

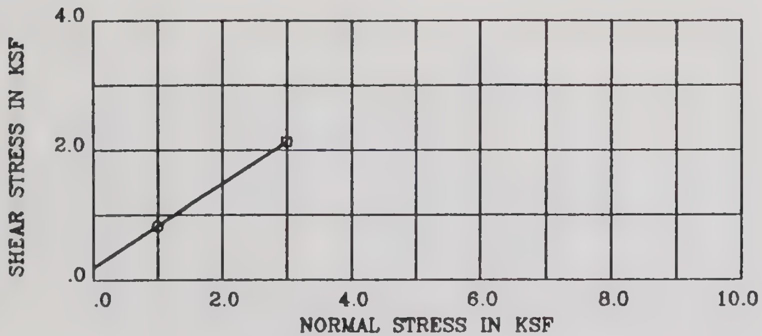
Table 1 - continued

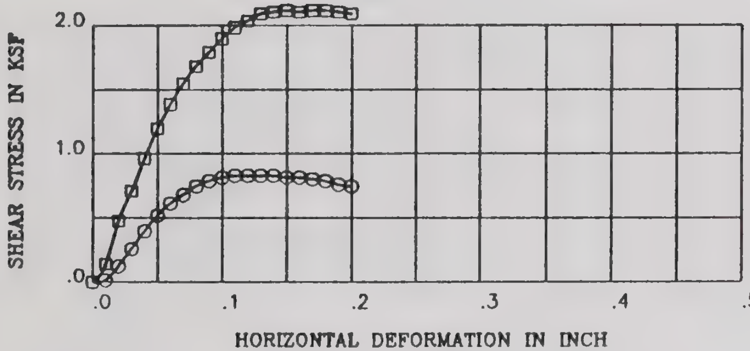
Summary of Moisture, Density, Swell and Direct Shear Testing

		In-Place Conditions		Swell Tests			Direct Shear Testing	
Sample Number	Depth (Ft.)	Dry Density pcf	Moisture Content % Dry Wt	Swell Index (A)	% Swell	Moisture Increase % (B)	Angle Of Internal Friction Degrees	Unit Cohesion psf
A11-1	4	91	9					
A11-2	9	102	20					
A11-3	14	105	20				27	470
A11-4	19	102	22					
A11-5	24	99	25					
A11-6	29	96	28					
A11-7	34	118	11					
A11-8	39	-	5					
A12-1	4	89	30					
A12-2	9	104	23					
A12-3	14	95	29					
A12-4	19	96	25					
A12-5	24	-	22					
A12-6	29	95	26					
A12-7	34	105	21					
A12-8	39	103	22					

NOTES: (A) - Swell Index equals percent swell divided by percent moisture increase.

(B) - Moisture Increase following at least 24 hours of soaking prior to testing.



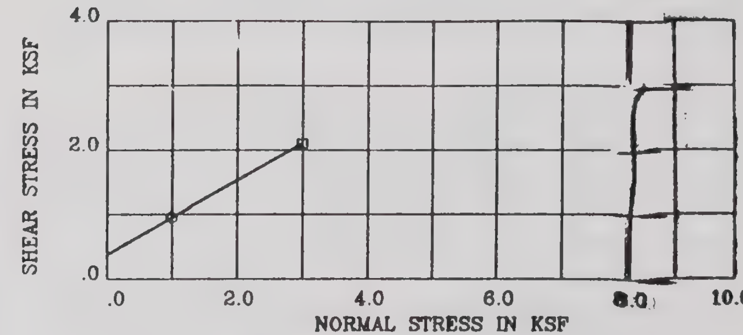


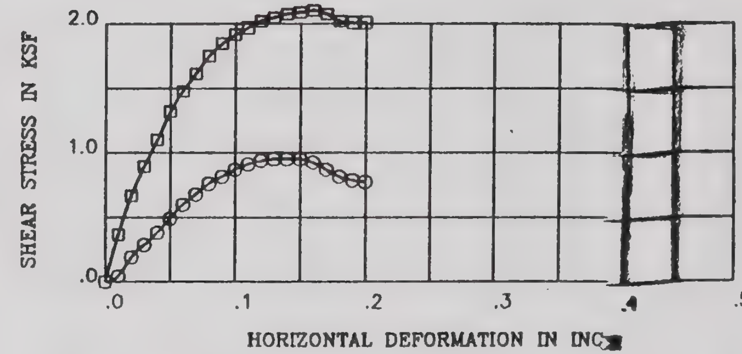
BORING/SAMPLE : A5-4-2/1 DEPTH (ft) : 14/13.5
DESCRIPTION : Sand poorly graded, med.
STRENGTH INTERCEPT (C) : .184 KSF (PEAK STRENGTH)
FRICTION ANGLE (PHI) : 32.8 DEG (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	11.7	90.4	.863	1.00	.83	.75
□	20.3	91.9	.834	3.00	2.12	2.09

Remark : Mottled brn and ol brn Sand w/silt (SP). Moist.

C6-2280-C1	
Earth Systems	DIRECT SHEAR TEST



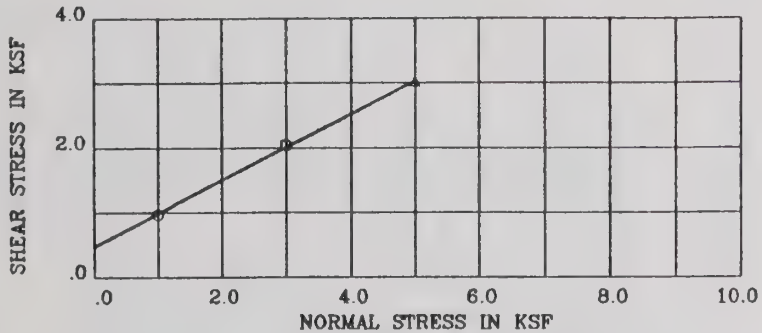


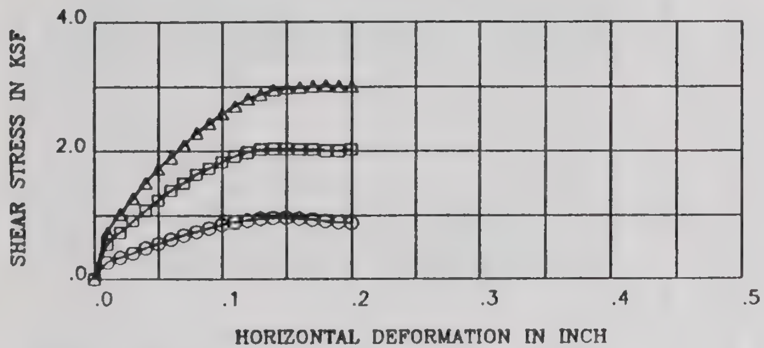
BORING/SAMPLE : A5-4-2 DEPTH (ft) : 14
DESCRIPTION : Sand poorly graded, fine.
STRENGTH INTERCEPT (C) : .375 KSF (PEAK STRENGTH)
FRICTION ANGLE (PHI) : 29.9 DEG (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.4	95.2	.770	1.00	[illegible]	.77
□	23.0	99.4	.695	3.00	2.10	2.01

Remark : Mottled olive brn and brn silty sand (SM).

C6-2280-C1	
Earth Systems	DIRECT SHEAR TEST





BORING/SAMPLE	: A11-3-1	DEPTH (ft) : 14		
DESCRIPTION	: Moist med stiff			
STRENGTH INTERCEPT (C)	:	.470	KSF	(PEAK STRENGTH)
FRICTION ANGLE (PHI)	:	27.1	DEG	(PEAK STRENGTH)

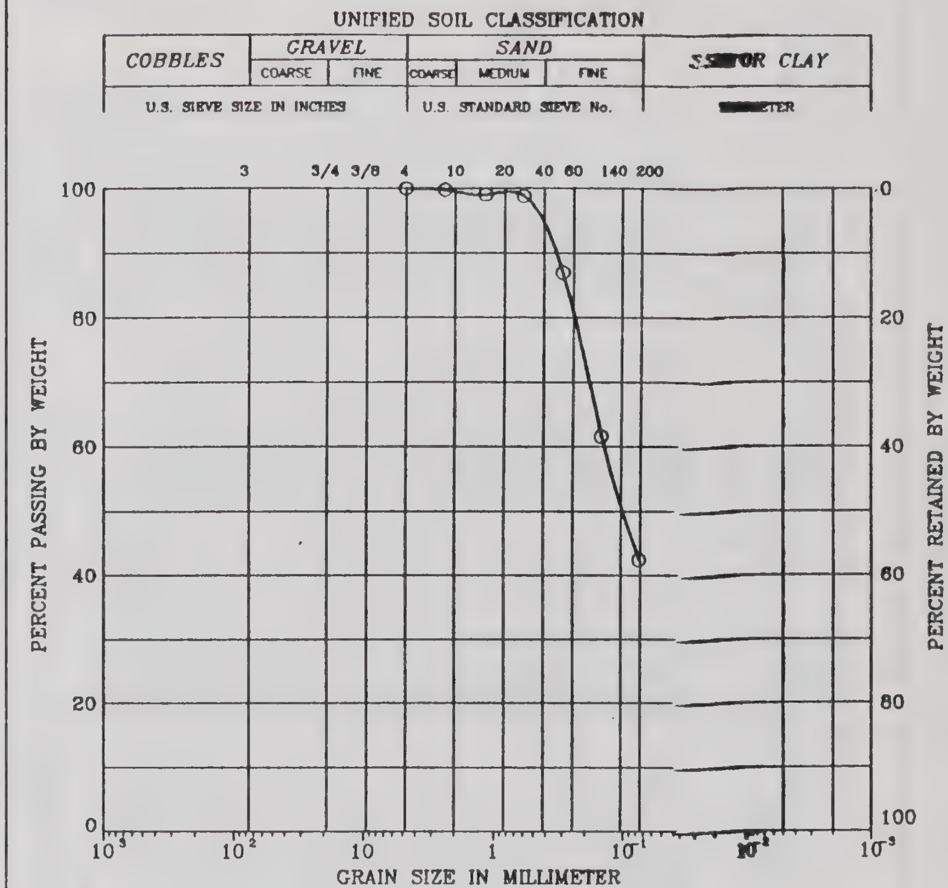
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	20.3	103.6	.626	1.00	.97	.88
□	19.9	107.3	.570	3.00	2.04	2.01
△	20.5	104.1	.619	5.00	3.01	3.00

Remark : Mtld dk gryish brn lt olive brn sl sa w/minor cl

C6-2280-C1

Earth Systems

DIRECT SHEAR TEST



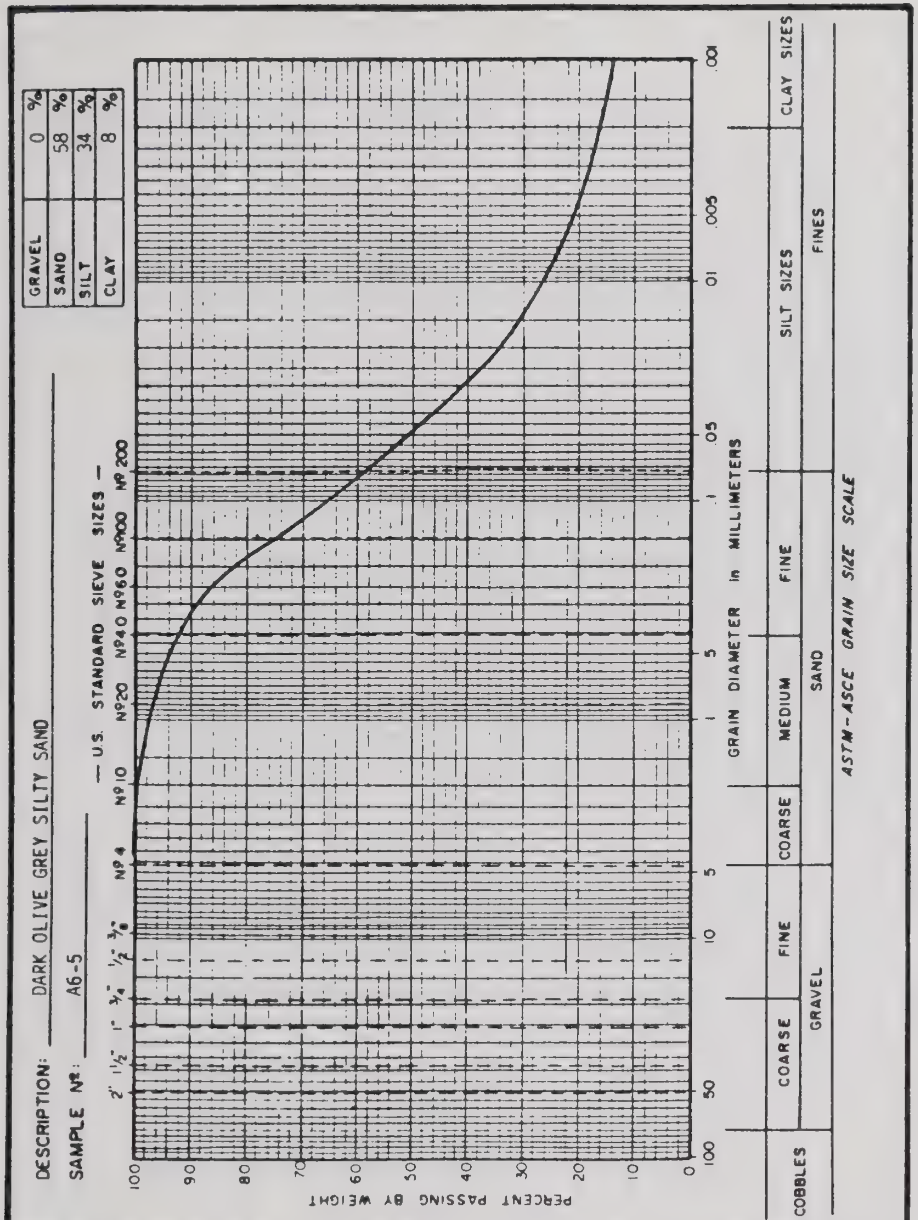
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	A3-4-2				V dk ol brn Sandy Silt w/clay (ML)

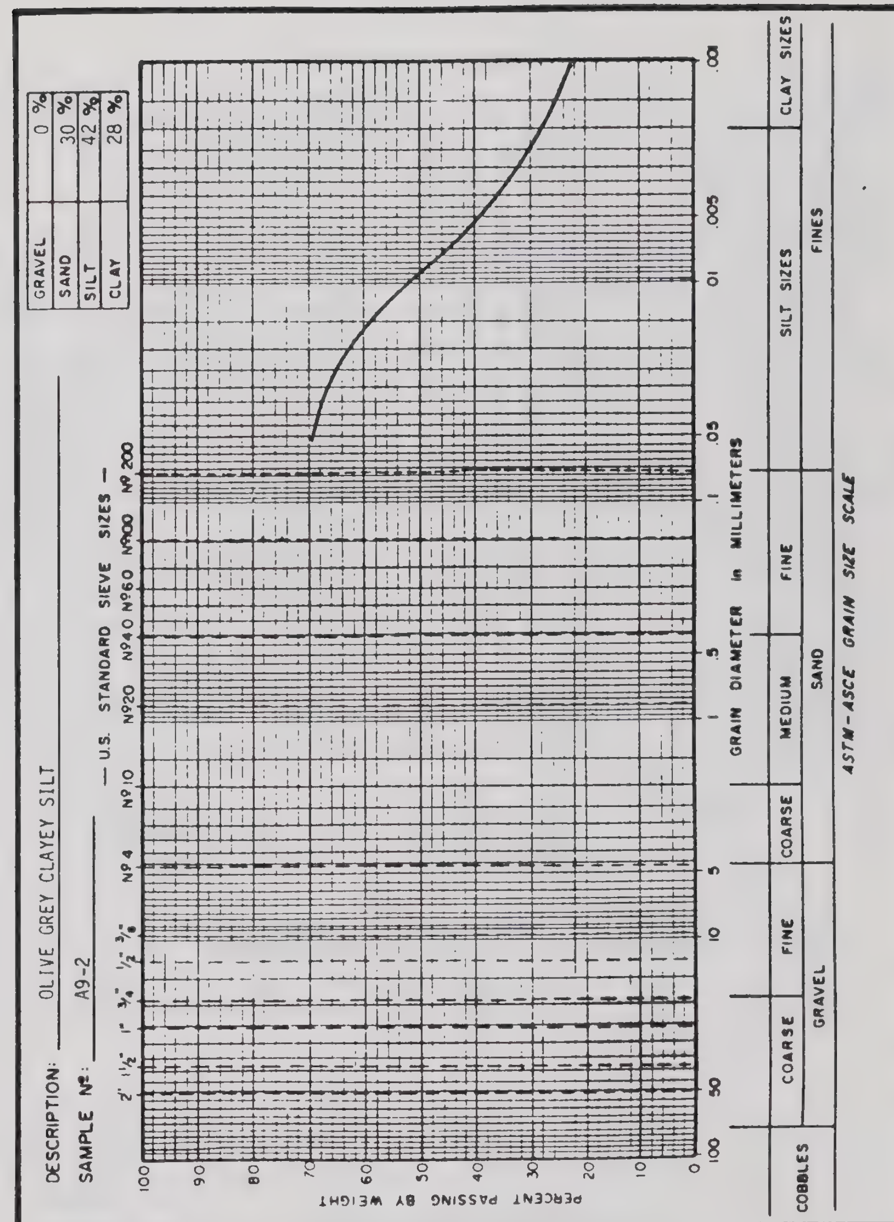
Remark :

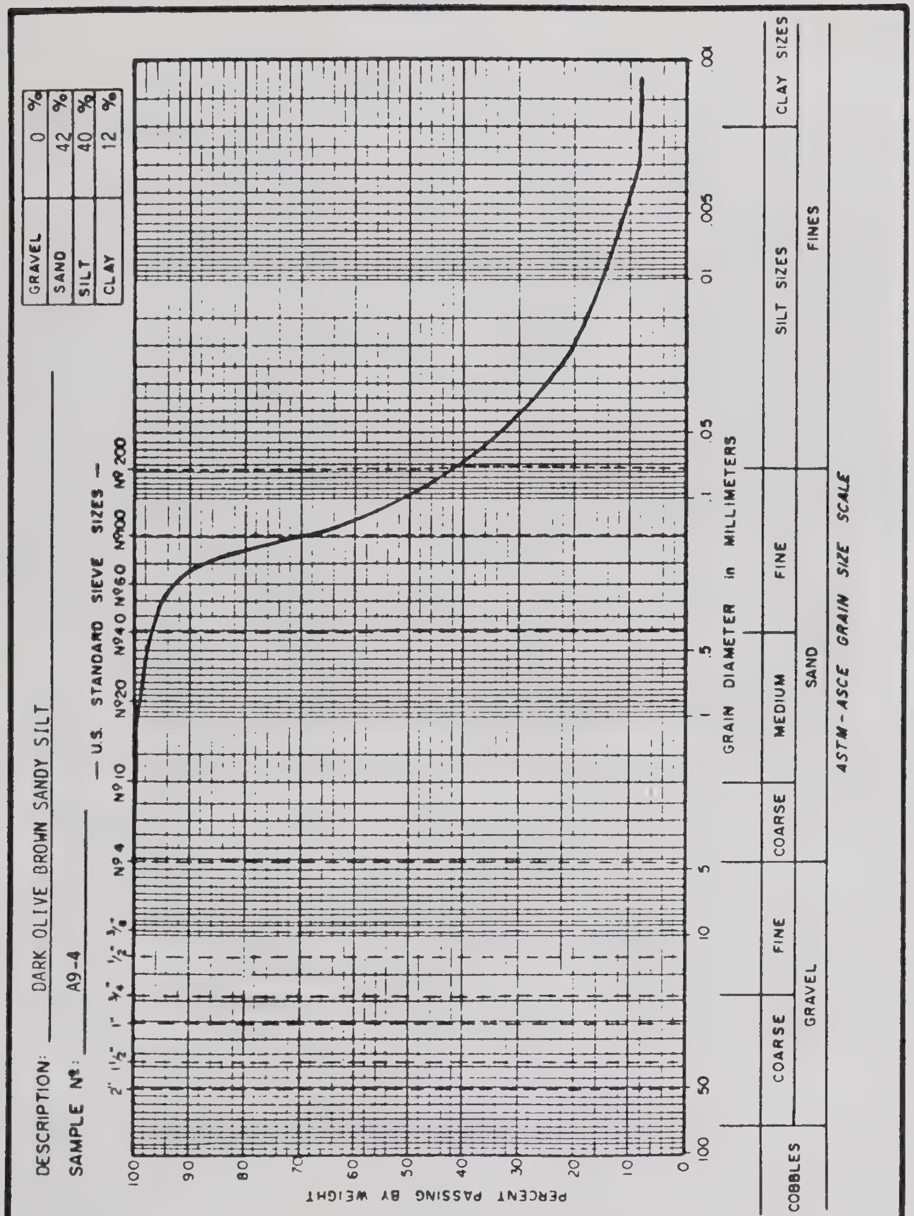
C6-2280-C1

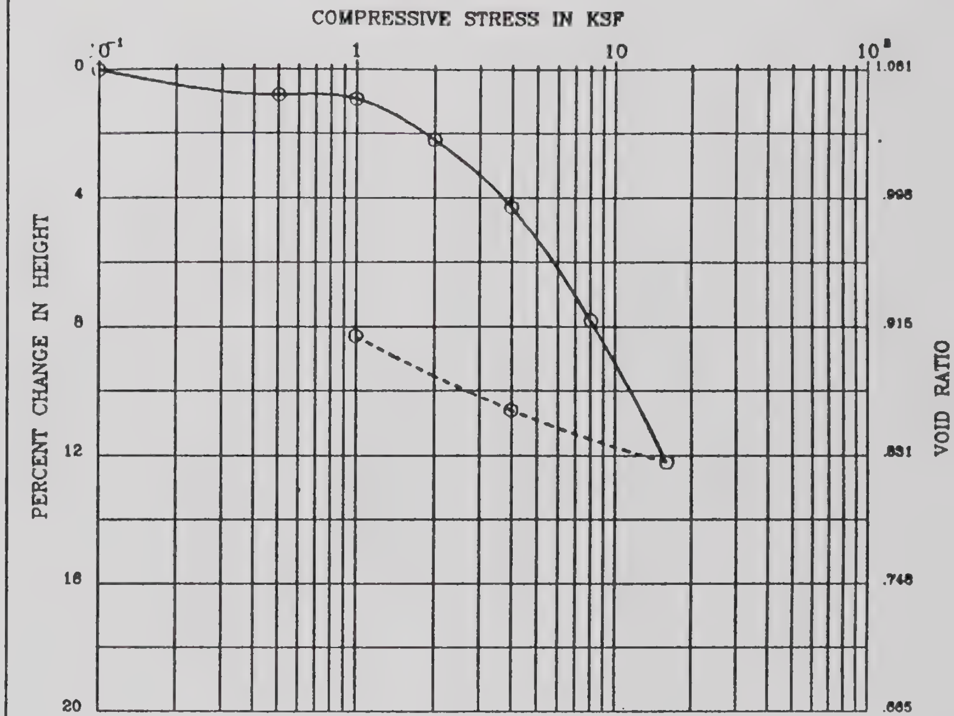
Earth Systems

GRAIN SIZE DISTRIBUTION


DESCRIPTION: DARK OLIVE GREY SILTY SAND
SAMPLE Nº: A6-5
GRAVEL 0 %
SAND 58 %
SILT 34 %
CLAY 8 %
U.S. STANDARD SIEVE SIZES
GRAIN DIAMETER in MILLIMETERS
PERCENT PASSING BY WEIGHT
COBBLES
GRAVEL COARSE FINE
SAND COARSE MEDIUM FINE
FINES SILT SIZES CLAY SIZES
ASTM-ASCE GRAIN SIZE SCALE


DESCRIPTION: OLIVE GREY CLAYEY SILT
SAMPLE Nº: A9-2
GRAVEL 0 %
SAND 30 %
SILT 42 %
CLAY 28 %
U.S. STANDARD SIEVE SIZES
GRAIN DIAMETER in MILLIMETERS
PERCENT PASSING BY WEIGHT
COBBLES
GRAVEL COARSE FINE
SAND COARSE MEDIUM FINE
FINES SILT SIZES CLAY SIZES
ASTM-ASCE GRAIN SIZE SCALE



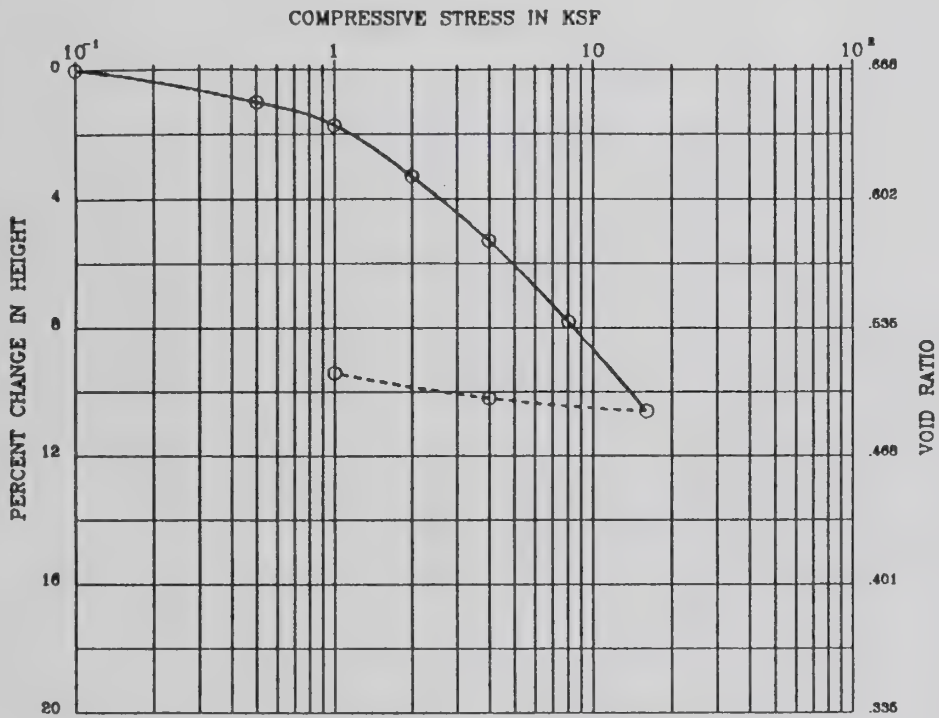


BORING	: A5-7-1	DESCRIPTION	: Fat clay CH/CL
DEPTH (ft)	: 28.5	LIQUID LIMIT	:
SPEC. GRAVITY	: 2.86	PLASTIC LIMIT	:

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	36.2	85.9	96	1.081
FINAL	31.7	93.7	100	.908

Remark : Very dark grey, moist, medium stiff

C6-2280-C1	
Earth Systems	CONSOLIDATION TEST



BORING	: A9-4-1	DESCRIPTION	:	Sandy lean clay with silt CL
DEPTH (ft)	: 19	LIQUID LIMIT	:	
SPEC. GRAVITY	: 2.72	PLASTIC LIMIT	:	

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	22.8	102.0	93	.668
FINAL	16.7	112.6	100	.511

Remark : Dark grayish brown, moist, medium stiff

C6-2280-C1

Earth Systems

CONSOLIDATION TEST

APPENDIX B

TECHNICAL REPORTS

SAN JOSE ARENA FACILITY

SITE B

SAN JOSE, CALIFORNIA

APPENDIX B-1

TRAFFIC AND CIRCULATION ANALYSIS

BARTON-ASCHMAN ASSOCIATES, INCORPORATED

SAN JOSE, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

SAN JOSE ARENA FACILITY TRAFFIC & PARKING IMPACT STUDY FOR SITE "B"

Prepared For:

THE REDEVELOPMENT AGENCY OF
THE CITY OF SAN JOSE

Prepared By:

Barton-Aschman Associates, Inc.
July 1987

SAN JOSE ARENA FACILITY

TRAFFIC & PARKING

IMPACT STUDY

FOR SITE B

Prepared For:

The Redevelopment Agency of
The City of San Jose

Prepared By:

Barton-Aschman Associates, Inc.

July 1987

23401515/TS/A Site B:87363

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

LIST OF TABLES

LIST OF FIGURES

1.

INTRODUCTION

The City of San Jose is considering the construction of an arena facility for indoor sporting events, entertainment, ice shows and concerts, and large meetings. The purpose of this report is to analyze the anticipated traffic, parking, pedestrians, and neighborhood impacts that would be created by a general-purpose indoor arena facility.

The proposed Site B is located in the vicinity of downtown San Jose: north of Julian Street, west of S.R. 87, south of the Southern Pacific railroad tracks (Oakland line) and east of the Guadalupe River (see Figure 1). Roadway access to the site would be available from West Santa Clara Street, West Julian Street, and Autumn Street.

For a comprehensive analysis of the potential impacts such a facility could have on the existing transportation infrastructure, five different time scenarios and two different seating capacities were considered in this study. The different time scenarios focused not only weekday evening events but also on Friday and Saturday evening events. One scenario investigated the impact of the arena on the PM peak hour commute traffic conditions. Another one dealt with the traffic conditions after the end of the arena events.

Two different attendance levels were considered in this study. While most of the events are expected to draw a maximum attendance level of 17,500 persons, it is anticipated that an attendance level of 20,000 persons may occur a few times a year.

The following chapters are sections on parking, traffic, pedestrian and neighborhood impacts. Each chapter discusses the existing conditions, outlines the assumptions used for the analysis, and presents the findings and recommendations. Conclusions drawn from this study are provided in the last chapter of this report.

Barton-Aschman Associates, Inc.

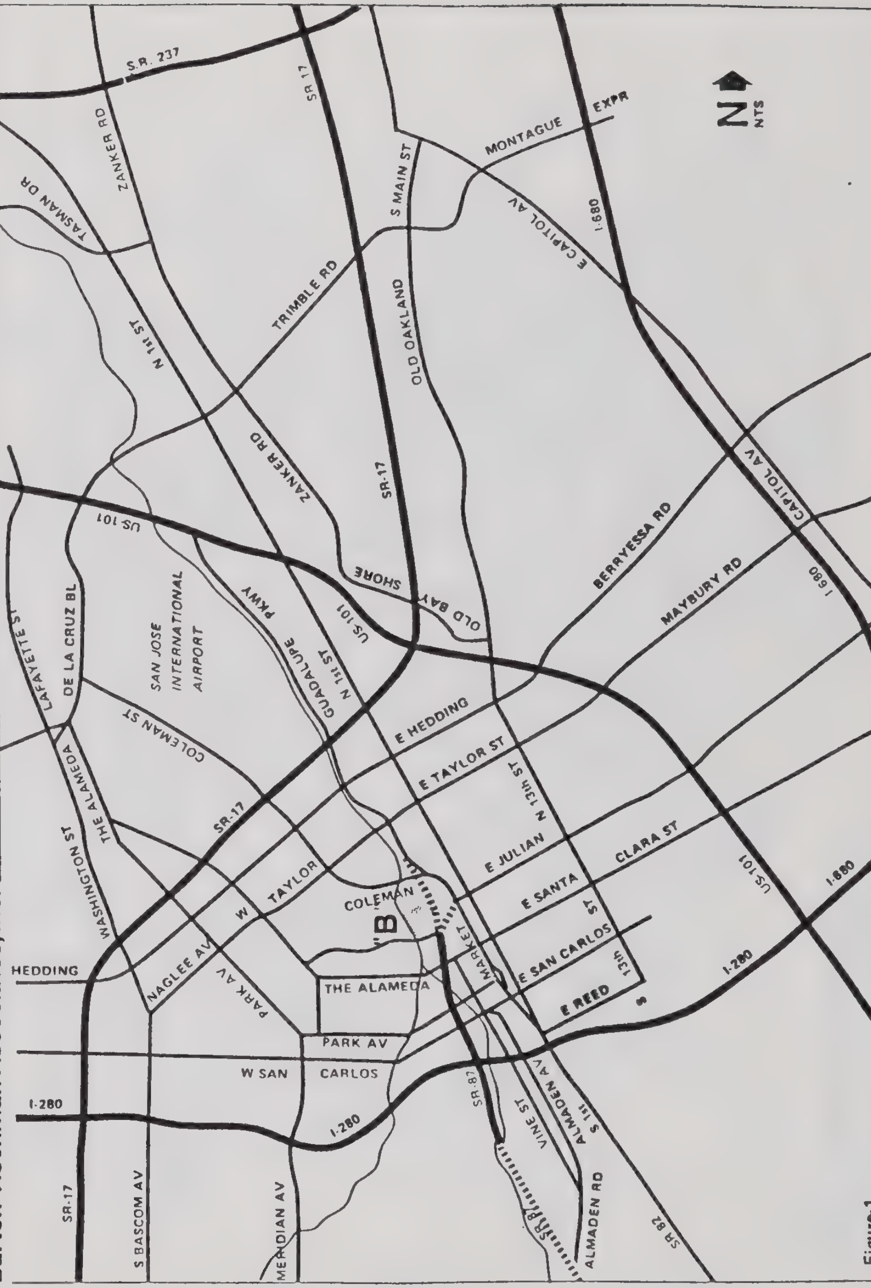


Figure-1

LOCATION OF ALTERNATIVE ARENA SITE "B"

2.

PARKING NEEDS AND SUPPLY

The parking demand characteristics of arenas vary greatly because of the differing type, attendance levels, and time of events. Also, the parking needs for arena events are influenced by the mode of arrival, the vehicle occupancy ratio, and the average and peak attendance levels.

The proposed arena on Site B is planned to accommodate different types of events. Each type of event would generate different parking demands. Broad categories of events would include professional sports, college sports, family shows, concerts, and community/convention functions.

This chapter summarizes the existing parking conditions, provides forecasts of parking demand with the arena, and discusses the provision of parking to serve the arena patron parking needs.

2.1 Existing Parking

A parking inventory and parking usage survey was conducted to assess the existing on-street and off-street available parking and utilization within 3,000 feet distance of Site B.

On-Street Parking Inventory

A parking inventory of the existing curbside (on-street) parking spaces was conducted in February 1987 for the study area. In the parking inventory the current parking restrictions were documented. There are nine different parking restrictions currently imposed on the available curbside spaces within the study area. The number of available parking spaces was identified for the curbs where parking is permitted. There exists a total number of 1,598 spaces, as indicated in Table 1. The on-street parking study area is shown in Figure 2.

On-Street Usage

A curbside on-street parking usage survey was conducted on a weekday in the evening period, between 7:30 PM and 8:30 PM. During the survey, all curbside spaces were visited, and the number of parked cars was counted. This survey provided information regarding the current demand for on-street parking in the evening.

On-street parking was analyzed by dividing the study area into nine zones, as shown in Figure 2. The on-street utilization is summarized in Table 1 for the evening period between 7:30 and 8:30 PM.

Barton-Aschman Associates, Inc.

Figure-2
ON-STREET PARKING
STUDY ZONE BOUNDARIES

TABLE 1
ON-STREET PARKING WEEKDAY EVENING UTILIZATION (7:30 to 8:30 PM)

Parking Zone	On-Street Spaces	Cars Parked	Percent Utilization
I	136	17	13%
II	225	57	25%
III	285	145	50%
IV	146	27	18%
V	200	35	18%
VI	134	23	17%
VII	145	69	48%
VIII	243	149	61%
IX	84	12	14%
TOTAL	1,598	534	33%

According to the parking utilization survey, Parking Zone VIII showed the highest usage of 61%. The next highest usage was in Zone III with 50% utilization. Zone V includes the area proposed for the arena. This zone had a low usage of 18%.

During the weekday evening period there is an overall usage of 33%. The evening parking is related to the existing land uses, and the highest utilization (61%) occurs in the commercial areas offering evening entertainment.

Off-Street Parking Inventory

The off-street parking inventory was conducted to determine the available parking spaces. These include the public and private surface lots and garages with a 3,000 feet of walking distance of Site B. Also, included in the inventory is the future parking spaces that will be available in the next four or five years as a result of the construction of new buildings. These buildings are either under construction or approved for construction in the next few years.

The inventory listed in Table 2 showed that there are 3,925 existing off-street parking spaces. The additional 2,391 off-street spaces that are either under construction or approved for construction will bring the total number of spaces to 6,316.

Off-Street Usage

The parking usage survey for the existing parking facilities was conducted for the afternoon peak between 2 and 3 PM and Friday evening peak period betwen 6 and 9 PM. The afternoon peak period surveys showed that the existing garages were over 80% utilized by the tenants of the buildings. The surface lots east of Route 87 are sparsely occupied with usage varying between 25% to 30%. The evening peak period utilization of the garages was reported to vary between 10% and 15%.

TABLE 2
OFF-STREET PARKING INVENTORY

Description		Parking Spaces
Existing Facilities		
1.	Surface Lot North of Julian St.	160
2.	Surface Lot North of Devine St.	170
3.	Surface Lot South of Devine St.	100
4.	Surface Lot North of St. John St.	75
5.	Market Street Garage	1,500
6.	Pacific Valley Bank Garage	700
7.	Park Center Plaza III	1,220
	Total Number of Existing Spaces	3,925
Facilities Under Construction or Approved for Construction		
1.	Boone Fox Building	873
2.	Herron Building	483
3.	William Wilson Building	715
4.	Parking Under Route 87	320
	Total Number of Proposed Spaces	2,391
	GRAND TOTAL	6,316

TABLE 3
OFF-STREET PARKING USAGE

Garage	Spaces	# of Cars Parked During Evening Peak Period	Percentage Utilization
Park Center Plaza I	1,076	283	26%
Park Center Plaza II	302	322	107%
Park Center Plaza III	1,220	148	12%
Market Street Garage	1,500	185	12%

Summary of Conclusions

The existing neighborhood on-street parking surveys were conducted to understand the existing parking supply and demand conditions. This on-street parking is not used in the parking supply analysis. The purpose of the analysis is not to advocate the use of neighborhood streets for parking. It is intended to provide background information that emphasizes the importance of providing sufficient on-site and garage parking without the use of neighborhood street parking supply.

The existing parking garage usage surveys indicated that the parking space utilization during the afternoon peak was over 80% whereas the surface lots east of Route 87 were used less than 30%. However, during the evenings the garage and the surface lots were used only 10% to 15%.

2.2 Arena Parking Demand

The parking demand for an arena at Site B will depend on the mode of arrival, the vehicle occupancy of the arena patrons, the starting and ending time of the arena events, and the size of the anticipated arena facility. Following is a brief discussion of each of these elements as they apply to the site.

Travel Mode

Use of the private automobile as an arrival mode to the arena is largely dependent on the cost of parking, the available parking supply, and the existence of other convenient transportation alternatives for the arena patrons.

Due to its location, none of the regular County Transit routes serve Site B. Also, the Cahill CalTrain station is about three-quarters of a mile away from the site. However, in the future it would be possible to provide express bus routes at a premium price. Charter buses could also bring Arena patrons.

The Light Rail system on North First Street will have a station at First and Saint James which is about 2,300 feet or a 10-minute walking distance from Site B.

For this study, it was assumed that less than 1% of the total arena patrons would use express and charter buses and 5% of the patrons living in the Almaden Valley and South San Jose would use Light Rail service to and from Site B. Use of CalTrain service would be an estimated 2% of the Peninsula patrons residing in the U.S. 101 travel corridor. Also, for the private automobile users a vehicle occupancy of 3.0 persons per vehicle was assumed.

Vehicle Occupancy

Vehicle occupancy for an arena varies by the type of event. For example, family shows, which attract many youngsters and senior citizens, normally have much higher person-per-car ratios than sporting or other events. In the past decade, the professional basketball games at the Oakland Coliseum averaged from 2.90 to 3.15 persons per vehicle. During the same period at the Coliseum, family shows ranged from 4.5 to 5.0 persons per car and concerts typically ranged between 3.5 and 4.0 persons per vehicle.

The firm of Coliseum Consultants is a member of the team for the study of alternative arena sites in San Jose. Based on their experience, the consultants recommend 3.0 persons per car as the average vehicle occupancy for this study. On the basis of this recommendation, a vehicle occupancy factor of 3.0 was adopted.

Peak Attendance Period

The attraction of people to events held at the proposed arena will depend largely on the patrons available leisure time. As a result, the majority of events will be held during evenings and on weekends to avoid conflicts with normal working hours.

Experience with other indoor arenas around the country has shown that most regularly scheduled professional sporting events are held on weekends and during weekday evenings. Certain other special events may have weekday show times although peak attendance usually occurs during evenings and on weekends. For this analysis, the parking demand was estimated for two time periods. The parking demand for the evening events was estimated based on the full capacity attendance for major events. The parking demand for afternoon events, consisting of family shows such as circuses and ice shows, was estimated for an average attendance level based on the experiences of other similar arena facilities around the country.

Arena Size

The proposed arena would be designed to host more than one type of attraction. Similar arenas are used for sporting events such as NBA basketball, ice hockey, professional boxing/wrestling, and tennis tournaments. In addition to the sporting events the arena would also host events not related to sports, for example concerts, ice shows, and circuses. For an arena facility intended for multiple uses, the regular event generating the largest parking demand should be the basis for determining parking provisions. For example, NBA basketball is considered to be an event that would occur with regularity.

The other important factor that should be considered in planning parking for an arena is the maximum seating capacity. In this study, two alternative seating capacities are being analyzed. The first alternative would provide 17,500 seats; the second alternative would provide 20,000 seats.

Parking Demand Estimates

The parking demand estimates for the 17,500 and 20,000 seats arena alternatives for evening full capacity attendance are shown in Table 4. The parking demand for weekday afternoon matinee arena events are also shown in the table.

The 17,500 seat arena would need 5,660 parking spaces for the weekday evening or on the weekends at the arena site or within a reasonable walking distance from the arena. Similarly, the 20,000 seat arena would need 6,470 parking spaces. Weekday afternoon matinee events would occur about 20 times a year. The average attendance for these afternoon events would be between 10,000 and 12,000 persons.[1] The matinee events would require 2,610 parking spaces.

---

[1] Coliseum Consultants Letter of June 10, 1987

TABLE 4
ARENA PATRONS MODE OF ARRIVAL AND PARKING DEMAND — SITE B

Attendance	Bus Users (persons)	Light Rail Users (persons)	CalTrain Users (persons)	Car Users (persons)	Required No. of Parking Spaces
Evening and Weekend Events:					
17,500	175	235	110	16,980	5,660
20,000	200	270	130	19,405	6,470
Weekday Afternoon Event:					
11,000	550	—	--	10,450	2,610

Due to the family orientation of matinee shows usually large family groups attend these events and arrive together in automobiles or vans. The vehicle occupancy for automobiles used to travel to such functions is also reported to be higher than average. A vehicle occupancy of 4.0 persons per automobile is not uncommon. The use of public transit system is very low. However, the use of charter buses to carry school children and senior citizens is very extensive. The estimated number of parking spaces required for matinee events is based on an average attendance of 11,000 persons per event, an average vehicle occupancy of 4.0 persons per car with 5% arrivals by charter buses.

2.3 Parking Supply

The parking demand for an arena can be satisfied in a number of different ways depending on the day and the time the events are held. Some of the methods to satisfy the arena parking demand include the following:

1) Provide parking on the site.
2) Use the existing surrounding parking supply that is (a) within an acceptable walking distance and (b) having non-concurrent parking demand.
3) Provide a remote parking area with a shuttle bus operation to the arena.

To satisfy the parking demand for Site B, the first two of the strategies were adopted. Due to the size of the available parcels, not all parking could be accommodated on site. It would be necessary to utilize existing parking facilities that are available during the evenings and on the weekends and that are within an acceptable walking distance.

Research has shown that most parkers will accept walking distances ranging up to 1,500 feet between the parking facility and the nearest entrance to their destinations, and some parkers will accept walks of 2,000 feet or more. A relationship between walking distance and the use of parking facilities by the arena patrons was developed based on previous experience at similar arena sites in other cities. A graph showing the relationship between walking distance and the percentage use of a parking facility is shown in Figure 3. This relationship was verified by the results of a study conducted for the acceptance of walking distance to rapid transit stations.[2]

Recent studies have indicated that there is an upper limit to the tolerance of walking distances under North American conditions. Although, the trip purpose has some bearing on the length of the walking distance between the parking area and the final destination. For example, people going to arena for recreational purposes are willing to accept longer than usual distances (over 3,000 feet) as compared to shopping trips which require carrying of shopping bags, etc. In short, the tolerance of arena patrons has been observed to be high for accepting longer than usual walking distances.

Available Parking for Weekdays, Evenings, and Weekends

Site B would provide 2,020 parking spaces for the exclusive use of arena patrons. The remainder of the parking supply would have to be met by utilizing the available parking facilities within an acceptable walking distance. The inventory of available off-street parking spaces outlined in the earlier part of this chapter showed that 6,316 spaces would be available. In order to determine the percentage utilization of the parking facilities, the walking distance between each parking facility and Site B was measured. The parking facility locations are shown in Figure 4. The walking-distance and percentage-use graph discussed above and shown in Figure 3 was used to estimate the number of spaces that are likely to be used by arena patrons. Table 5 shows that there are 9,046 available parking spaces and that 6,490 parking spaces could possibly be used based on acceptable walking distances.

It should be noted that this analysis assumes that arena events would be held on weekday evenings starting at 7:30 PM or on the weekends. These parking facilities are fully utilized on weekdays between 7 AM and 5 PM by the occupants of the building they were designed to serve. It will be necessary to obtain permission from the owners of the parking facilities for their use by arena patrons.

Available Parking for Weekday Afternoons

The parking demand for weekday afternoon events was estimated to be 2,610 spaces 2,020 parking spaces will be available on-site for these events. The 320 spaces under Route 87 could be reserved for days when the afternoon events are scheduled. The remaining 270 parkers would be absorbed in the 10 available parking areas.

2 Reference: Travel Behavior Associated with Land Uses Adjacent to Rapid Transit Stations, by M.G.P. Stringham.

Barton-Aschman Associates, Inc.

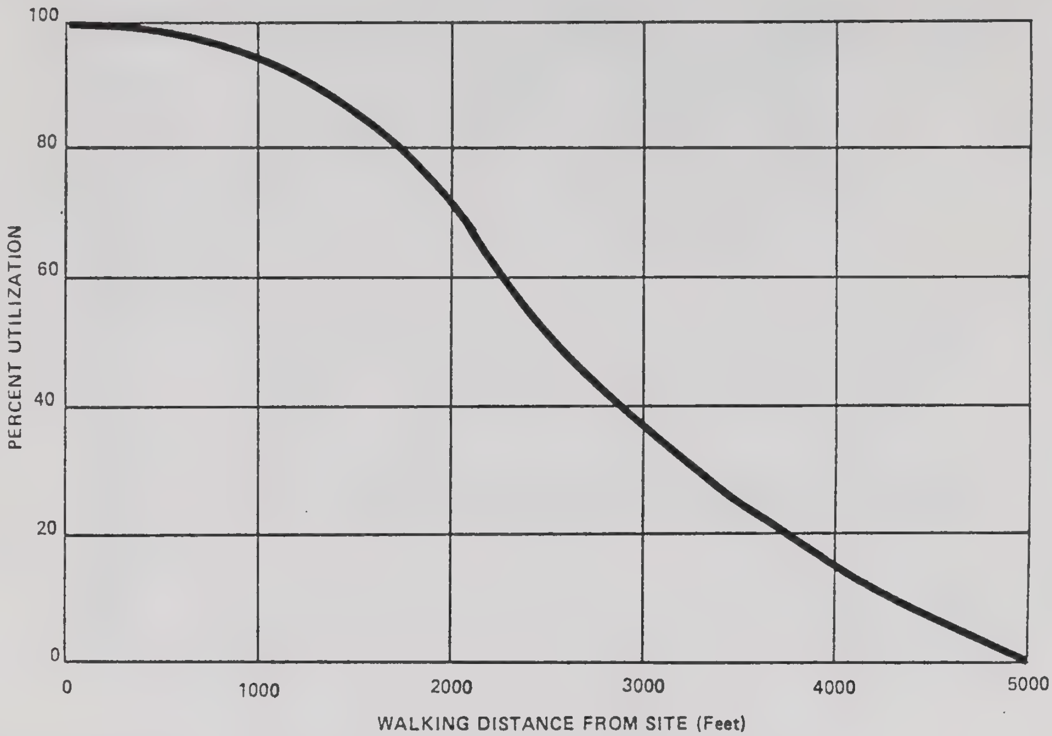


Figure-3

PARKING FACILITY UTILIZATION

Barton-Aschman Associates, Inc.

Figure-4

SITE "B" AVAILABLE PARKING FACILITIES

TABLE 5
PARKING SUPPLY AND ESTIMATED PARKING USAGE BY ARENA PATRONS — SITE B

Parking* Facility Number	Description	Total Available Spaces	Assumed Percentage Use	Estimated Parking Spaces Used
1	On-Site	2,020	100%	2,020
2	Parking Area West of Guadalupe River	330	100%	330
3	Surface Lot East of Route 87	150	100%	150
4	Surface Lot East of Route 87	250	100%	250
5	Surface Lot East of Route 87	160	100%	160
6	Surface Lot East of Route 87	170	100%	170
7	Surface Lot East of Route 87	100	80%	80
8	Surface Lot East of Route 87	75	100%	75
9	Pacific Valley Bank Garage	700	70%	490
10	Bonne-Fox Bldg.	873	68%	595
11	Market Street Garage	1,500	60%	900
12	William Wilson Bldg.	715	68%	486
13	Herron Bldg.	483	50%	242
14	Parking Area Under Route 87	320	35%	115
15	Park Center Plaza III	1,200	35%	427
	TOTAL	9,046	72%	6,490

* For Location Refer to Figure 4.

Employee Parking

The parking areas on-site will be reserved for customers. Therefore arena employees would not be allowed to park there. In order to satisfy the employee parking demand it would be necessary to establish a remote parking area for their use. The employees would be required to park at this location.

Conclusions

According to the available parking supply analysis there would be 6,490 parking spaces available for arena patrons for evening and weekend performances. The parking demand analysis showed that there would be a need for 5,660 spaces for a 17,500 seat arena and 6,470 spaces for a 20,000 seat facility. Therefore, there would be an excess of about 830 available parking spaces for arena patrons for the 17,500 seat arena and 20 spaces for the 20,000 seat arena in the general area. This surplus would ensure sufficient parking supply for arena patrons for evening and weekend events without relying on the neighborhood street parking spaces.

The weekday afternoon shows would require an estimated 2,610 spaces. All but 270 spaces could be reserved for these events. The several private parking facilities could satisfy the remaining demand of 270 spaces.

It is worth pointing out that the surface parking lots located east of Route 87 may be replaced by other developments in the future. However, in all probability the new developments would each provide its own parking which would still be available for arena patrons during evenings and weekends.

2.4 Proposed Parking Strategies

The parking demand and supply analysis outlined in this chapter led to the following parking strategy.

- Site B would provide 2,020 parking spaces on site. These spaces should be reserved for arena patrons only.
- A comprehensive long term plan should be prepared to provide parking for arena employees at a location away from the site. This arrangement should be strictly enforced.
- Arrangements should be made to provide parking areas for truck-trailers and rigs used for arena events, away from the site during the arena performance. This arrangement should be strictly enforced.
- Arrangements should be made to provide on-site parking for charter buses by arena patrons.
- In order to ensure the availability of privately owned parking facilities for arena patrons, arrangements should be made with the owners of these facilities.
- The parking demand for afternoon matinee events should be monitored closely. If the demand exceeds the supply, arrangements should be made to increase the parking at or near the arena.

3.

TRAFFIC IMPACT ANALYSIS

The objective of this analysis is to determine how the transportation system will be affected by the arena project. For a complete traffic analysis of the site under consideration, five different time scenarios were considered for each of two different seating capacities. The five scenarios are:

1. Weekday PM Peak Hour Analysis (between 4:00 and 6:00 PM) with an arena event starting time of 6:00 PM.

2. Weekday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.

3. Weekday Late Evening Peak Hour Analysis (between 10:00 PM and 12:00 Midnight) with an arena event ending time of 10:30 PM.

4. Friday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.

5. Saturday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.

The two different seating capacities considered are 17,500 seats and 20,000 seats.

For matinee events between 1:30 and 4:00 PM, a traffic analysis was not conducted because the attendance at these events is projected to be only 11,000 persons, which is not as critical as the 17,500 or 20,000 persons attendance level for the weekday PM peak hour.

The different scenarios were evaluated for existing, Year 1991, and Year 2000 traffic conditions.

3.1 Existing Conditions

The City of San Jose selected twenty critical intersections around the proposed Site B for traffic impact analysis. These locations are shown in Figure 5. Descriptions of the tasks performed and analyses conducted for evaluating existing conditions are provided in the following sections.

<u>Data Collection</u>

Data collected for similar arena facilities in other areas indicated that about 93% of the arena patrons arrive during the hour before the start of the event. For events starting at 7:30 PM, approximately 4% would arrive during the PM peak hour between 5 PM and 6 PM and the remaining 3% would arrive at other times.

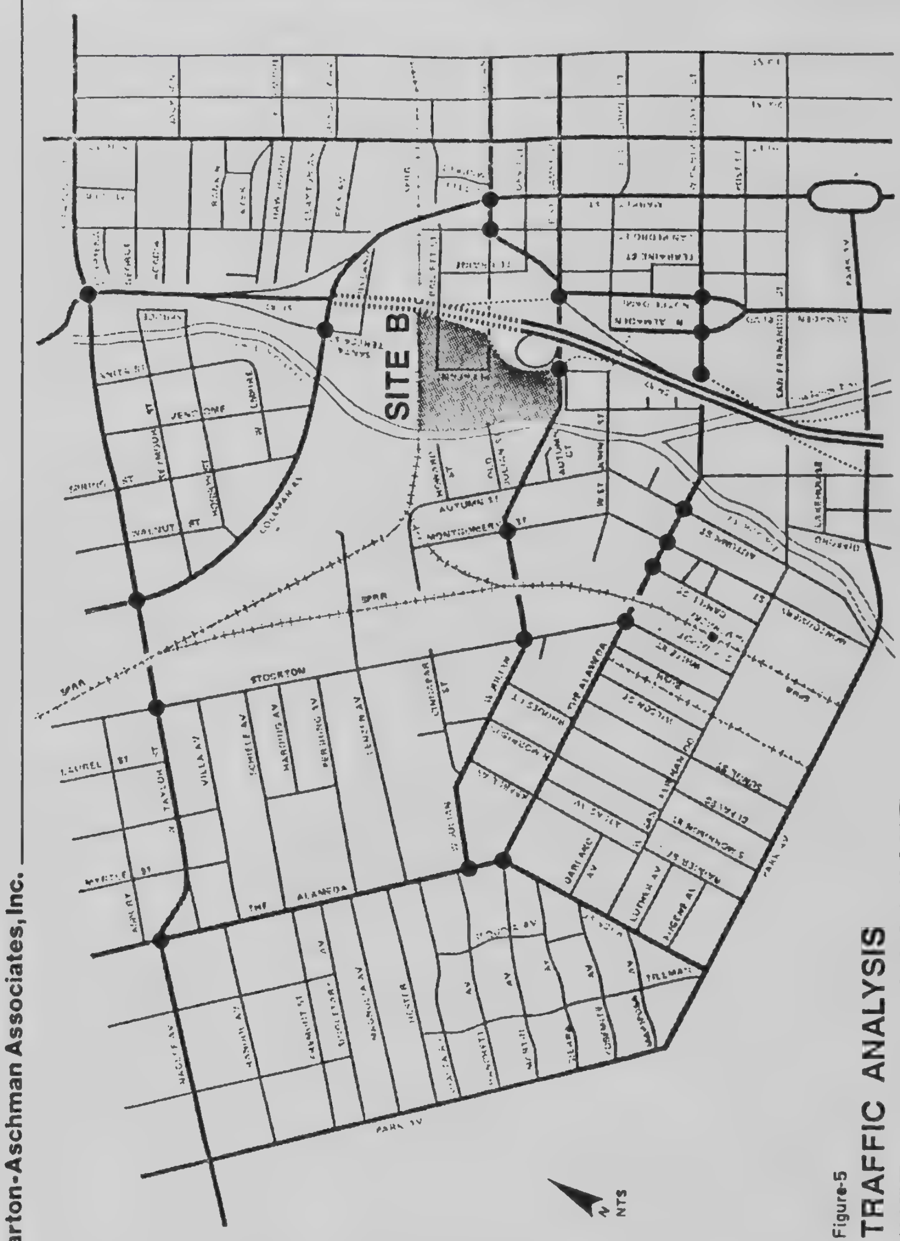


Figure-5
TRAFFIC ANALYSIS
INTERSECTION LOCATIONS

Barton-Aschman Associates, Inc.

The departure pattern varies more so by type of event. For example, it has been noted that for basketball events, an estimated 48% of the patrons leave before the end of the event, while for entertainment events, only 7% were found to have departed the surveyed site prior to the conclusion of the event.

Approximately two or three times a year, arena events may begin as early as 6:00 PM. These are events which would be broadcasted to audiences nationwide.[3] For these events, the peak hour of arena patron arrival would occur during the PM peak period. However, the starting time for most arena events is expected to be 7:30 PM, with the peak hour for arena patron arrival occurring between 6:30 and 7:30 PM. Likewise, an event with an ending time around 10:30 PM would result in a peak hour for arena patron departure of around 10:30 to 11:30 PM.

The traffic counts for the PM peak hour were obtained from the City of San Jose. For intersection locations where counts were taken during the previous years, an annual growth factor of 3.6 percent was applied to reflect existing (1987) traffic conditions. The peak hour counts for the remaining time periods were obtained from recent manual turning movement counts conducted by Barton-Aschman Associates, Inc. Traffic counts were taken during the evening period between 6:30 and 8:30 PM and the late evening period between 10:00 PM and Midnight. The traffic counts conducted on Friday evenings between 6:30 and 8:30 PM reflected the increased activity level of the general area. The Center of Performing Arts, Montgomery Theatre, and Civic Auditorium are all located in the vicinity of the proposed site. On the Friday evenings when the counts were conducted, these facilities held events that attracted peak season crowds.

Intersection Operation

The traffic conditions at an intersection can be described in the terms of Level of Service (LOS). Level of Service is a qualitative description of an intersection's operation based on the amount of traffic, conflicting traffic movements, delays and congestion. Levels of Service can range from A, representing free flow conditions, to F, representing jammed conditions. Generally, the Level of Service is derived from the ratio of traffic volumes and available capacity shown as V/C ratios. The various levels of service, their descriptions and range of V/C ratios are shown in Table 6.

A signalized intersection's level of service can be calculated with a number of different methods. The City of San Jose has adopted its own method which is based on critical traffic movements. In this method the volume of cars completing the turning movements that dictate the operation of the intersection are added together. The sum is divided by the capacity of the movements, and a volume to capacity ratio is obtained. The volume-to-capacity ratio is correlated to a level of service described in Table 6.

An intersection operating under stop control can be evaluated using the methodology described in the Highway Capacity Manual, Special Report 209; published by the Transportation Research Board. Unlike the level of service definitions given in Table 6 for signalized intersections, the level of service criteria for this methodology are stated in very general terms, and are related to general delay and reserve capacity ranges.

---

[3] Telephone Conversation with Mr. Bill Cunningham, July 16, 1987.

TABLE 6
INTERSECTION LEVEL OF SERVICE DEFINITIONS

Level of Service	Interpretation	V/C Ratio
A, B	Uncongested operations; all queues clear in a single signal cycle.	Less Than .7
C	Light congestion; occasional backups on critical approaches.	.700 - .799
D	Significant congestion on critical approaches but intersection functional. Cars required to wait through more than one cycle during short peaks. No long-standing queues formed.	.800 - .899
E	Severe congestion with some long-standing queues on critical approaches. Blockage of intersection may occur if traffic signal does not provide for protected turning movements. Traffic queue may block nearby intersection(s) upstream of critical approach(es).	.900 - .999
F	Total breakdown, stop-and-go operation.	1.0 And Greater

Existing Intersection Level of Service:

The results of the level of service calculations performed for the twenty intersections for the different time periods are presented in Table 7. In general, the City of San Jose considers any intersection operating below Level of Service D, as unacceptable. The results of the intersection level of service analyses indicated the following number of intersections with unacceptable operations associated with each of the scenarios.

- Weekday PM peak hour: 5 intersections
- Weekday Evening peak hour: None
- Weekday Late Evening peak hour: None
- Friday Evening peak hour: 1 intersection
- Saturday Evening peak hour: None

Hourly Traffic Variation

Traffic volumes on the street system vary over the twenty-four hour period and over the seven days of the week. During the weekday AM and PM peak periods there are more vehicles on the roadways than during the mid-day period. At night, traffic volumes on most streets are relatively low. On the weekends, the average daily traffic (ADT) is lower than for a typical weekday.

Different types of roadway facilities have different hourly variations throughout the day. For example, major arterials carrying heavy commuter traffic have a different pattern from streets serving retail areas.

In order to determine the travel pattern for the area in the vicinity of Site B, 24-hour counts were conducted at the following locations (see Figure 6):

1. Almaden Boulevard south of Santa Clara.
2. Santa Clara Street east of Autumn.
3. The Alameda south of Shasta
4. Julian Street east of Southern Pacific overpass.
5. Shasta Avenue west of The Alameda (Friday and Saturday Count).
6. Hanchett Avenue west of The Alameda (Friday and Saturday Count).

The machine counts were taken in May 1987. The highest weekday and Saturday daily traffic volumes are given in Table 8. The hourly totals for these counts were plotted in graphical form to determine the hourly travel pattern, the traffic volumes during peak travel times, and the off-peak travel characteristics. The hourly variations for the six locations are shown in Figures 7 through 23.

The count data show that for all locations measured the weekday with the highest traffic volumes is Friday. Also, the amount of traffic on the roadways is higher on Fridays than on Saturdays. During the weekdays the AM peak hour traffic volumes are comparable to the PM peak hour volumes. Generally, the traffic volumes drop sharply after 6:00 PM.

It should be noted that these graphs clearly reflect the character of the street and the function that it performs. For example arterial streets carry a significant amount of

TABLE 7
EXISTING INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM		WKDY EVE.		WKDY LATE EVE.		FRI. EVE.		SAT. EVE.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C
Alameda & Taylor/Naglee	E	.928	A	.293	A	.136	A	.563	N.A.	
Stockton & Taylor	A	.462	A	.116	A	.047	A	.222	N.A.	
Coleman & Taylor	D	.821	A	.137	A	.079	A	.279	N.A.	
SR 87 & Taylor	C	.767	A	.337	A	.126	A	.474	N.A.	
SR 87 Off-Ramp (SB) & Coleman	F	1.072	A	.457	A	.176	A	.550	N.A.	
San Pedro & Julian	E/d/		C		A		E		A	
Market & Julian	E	.960	A	.325	A	.194	A	.436	A	.299
Alameda & Julian/Hanchett	B	.688	A	.210	A	.111	A	.362	A	.220
Stockton & Julian	D	.813	A	.225	A	.138	A	.369	A	.153
Montgomery & Julian	A	.501	A	.122	A	.047	A	.243		
SR 87 On-Ramp (SB) & Julian	N.A./c/		N.A.		N.A.		N.A.		N.A.	
SR 87 On-Ramp (NB)/Notre Dame & Julian	D	.811	A	.372	A	.084	A	.274	A	.138
Alameda/Race & Martin	C	.718	A	.242	A	.126	A	.360	A	.201
Stockton & Alameda	F/d/		A		A		A		A	
Cahill & Alameda	B	.645	A	.235	A	.115	A	.305	N.A.	
Montgomery & Alameda	A	.564	A	.186	A	.079	A	.279	A	.160
Autumn & Santa Clara	A	.353	A	.131	A	.080	A	.202	A	.112
SR 87 Off-Ramp (NB) & Santa Clara	N.A.		N.A.		N.A.		N.A.		N.A.	
Santa Teresa & Santa Clara	D	.845	A	.329	A	.171	A	.408	A	.230
Notre Dame & Santa Clara	B	.632	A	.246	A	.141	A	.400	A	.230

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections

Barton-Aschman Associates, Inc.

Figure-6
MACHINE COUNT LOCATIONS

TABLE 8
SUMMARY OF 24-HOUR MACHINE COUNTS

Count Location			24-Hour Traffic Volumes	
			Highest Weekday/a/	Saturday
1.	Almaden Boulevard south of Santa Clara	NB/b/	12,055	5,899
		SB/c/	9,966	4,460
		Total	22,021	10,359
2.	Santa Clara Street east of Autumn	EB	11,570	6,948
		WB	9,854	6,348
		Total	21,424	13,296
3.	The Alameda south of Shasta	NB	16,082	9,133
		SB	14,412	8,625
		Total	30,494	17,758
4.	Julian Street east of Southern Pacific overpass	EB/d/	5,663	2,297
		WB/e/	6,683	2,863
		Total	12,346	5,160
5.	Shasta Avenue west of The Alameda	EB	–	–
		WB	–	–
		Total	694	499
6.	Hanchett Avenue west of The Alameda	EB	–	–
		WB	–	–
		Total	2,556	1,241
7.	Stockton Avenue south of Lenzen/g/	NB	6,755	N.A./f/
		SB	6,718	
		Total	13,473	

/a/ At all count locations, highest weekday volumes occurred on Fridays
/b/ NB = Northbound
/c/ SB = Southbound
/d/ EB = Eastbound
/e/ WB = Westbound
/f/ N.A. = Not Available
/g/ Earlier count taken on January 29, 1987.

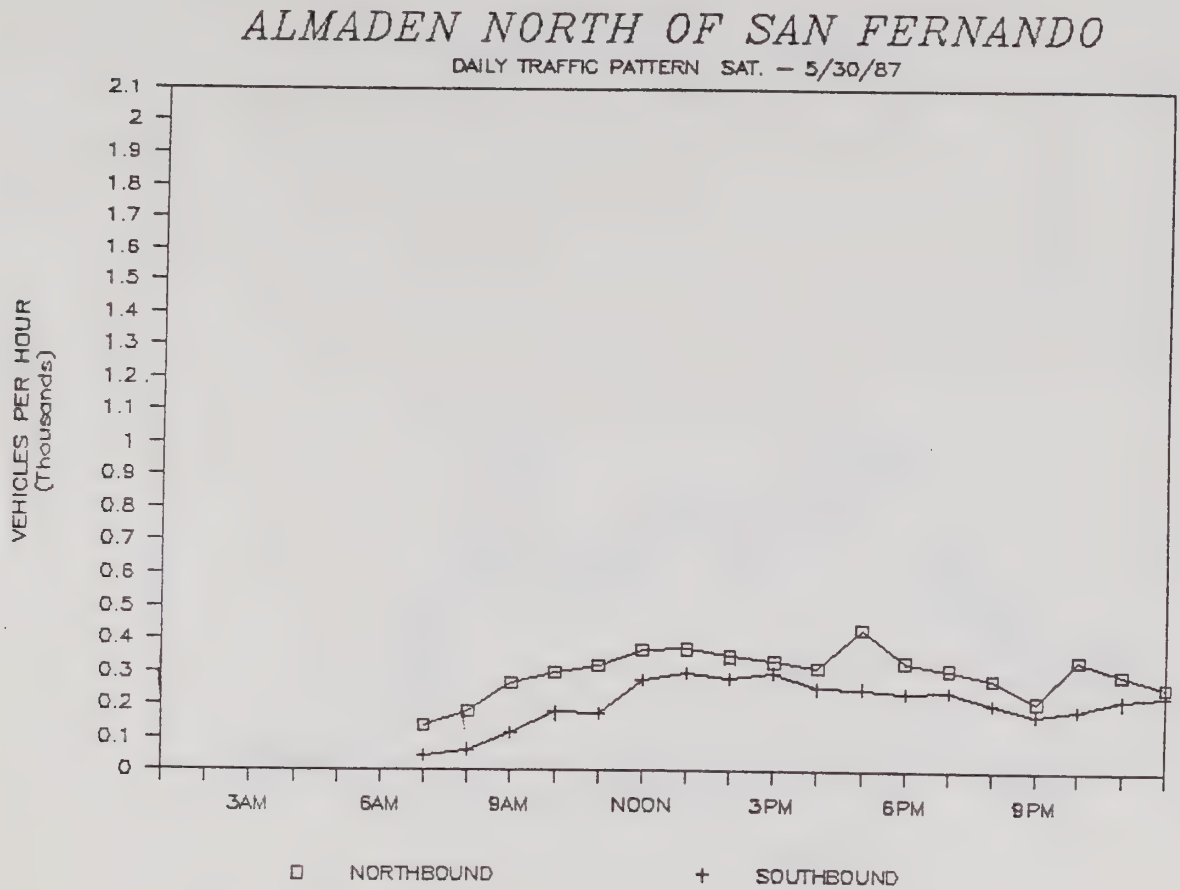


Figure-8

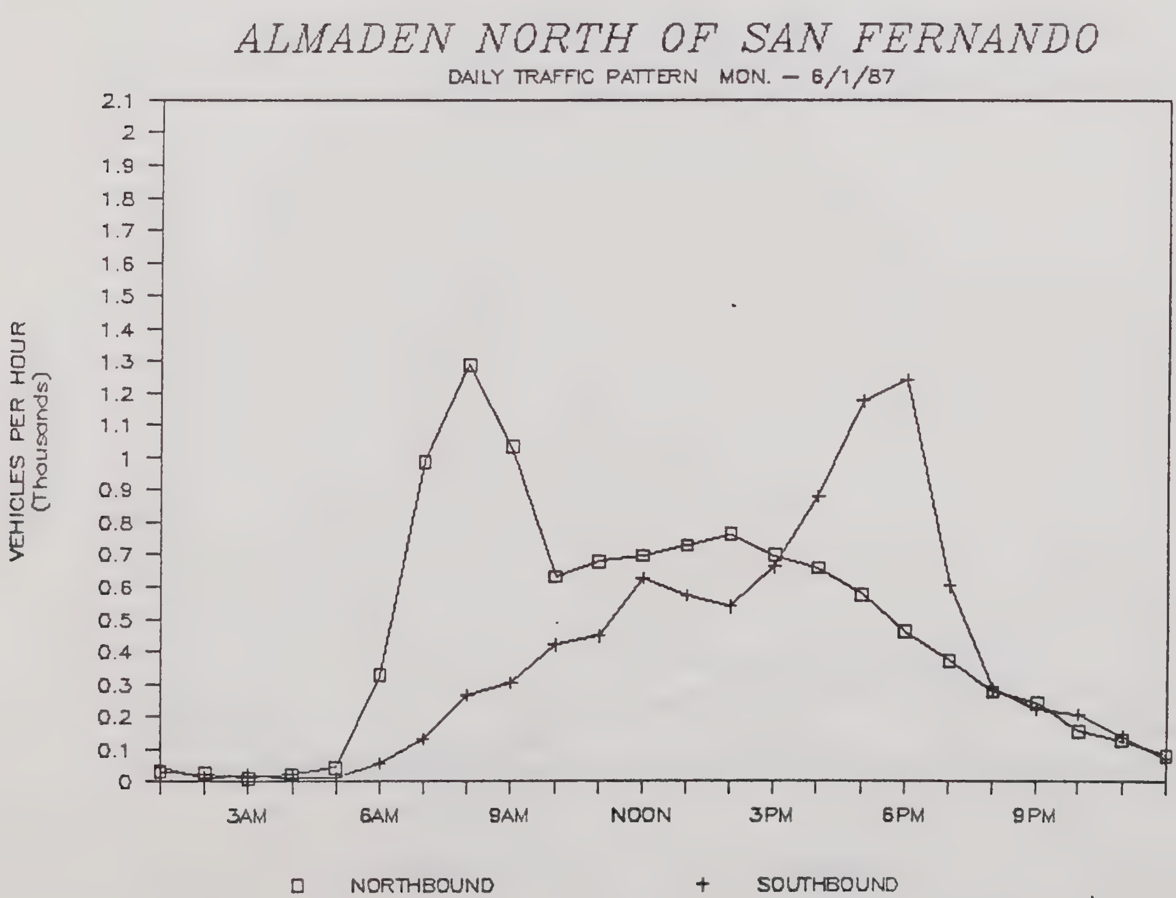


Figure-7

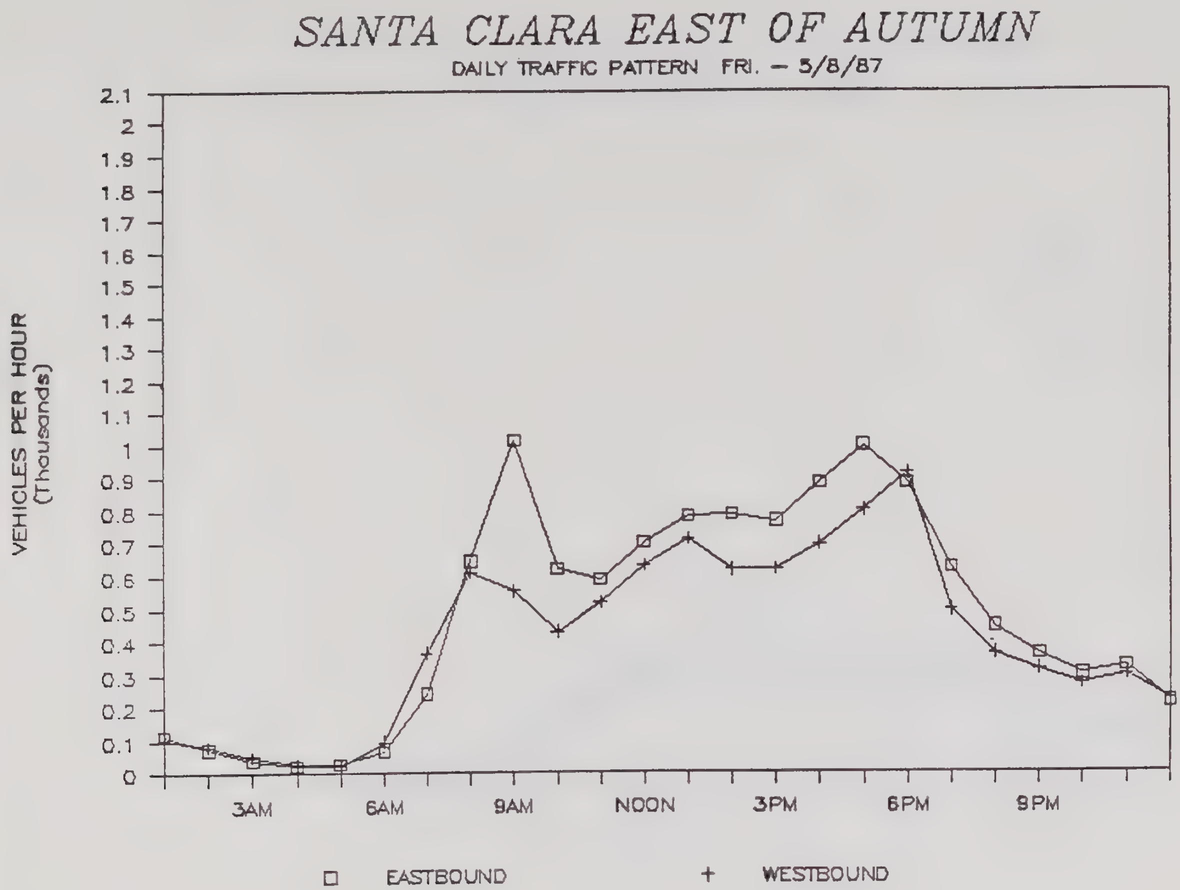


Figure-10

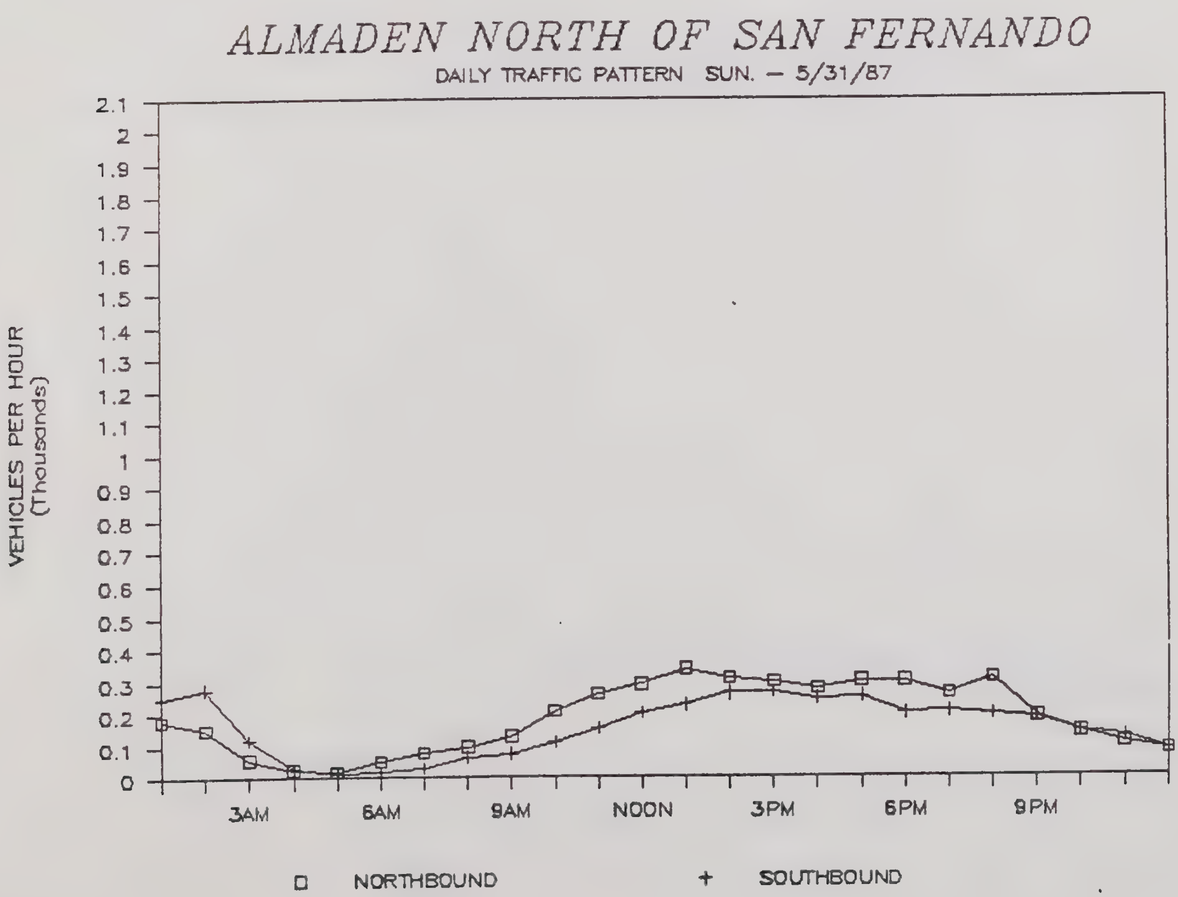


Figure-9

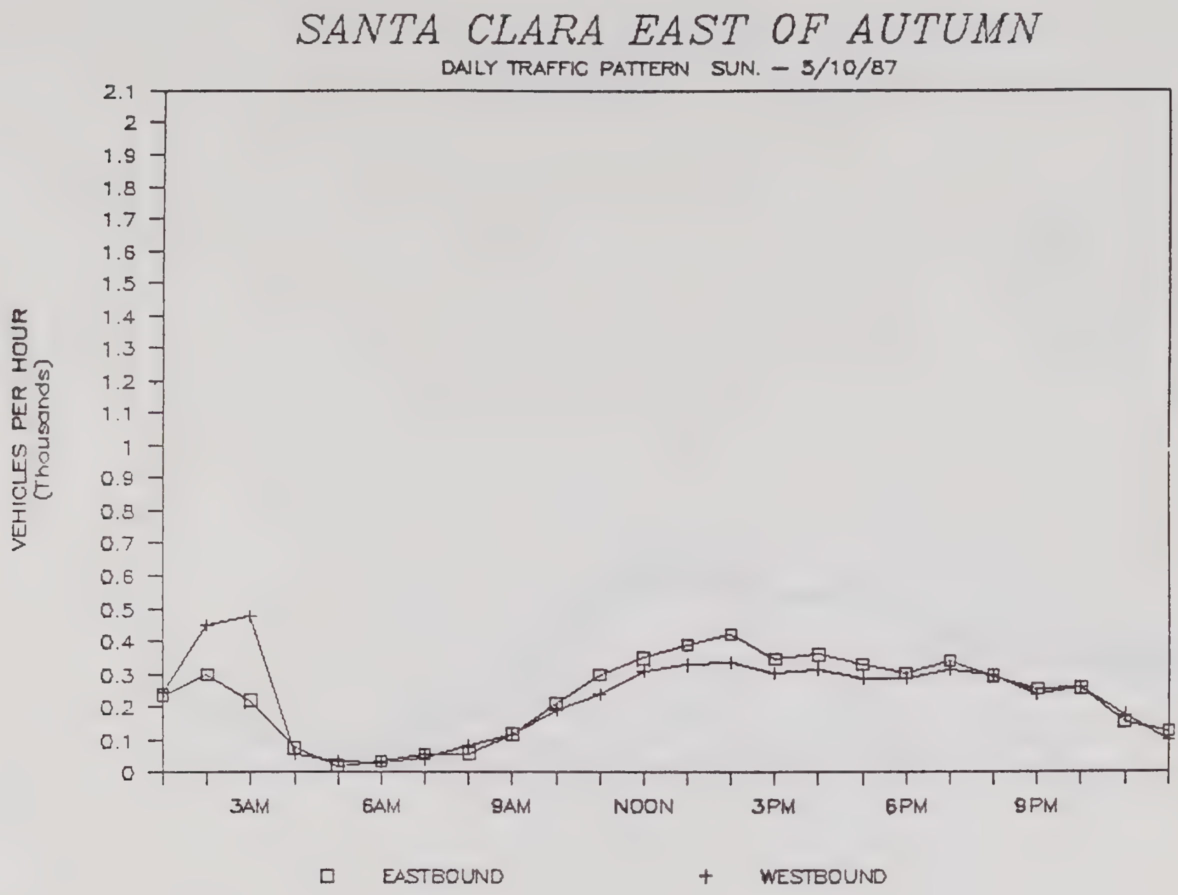


Figure-12

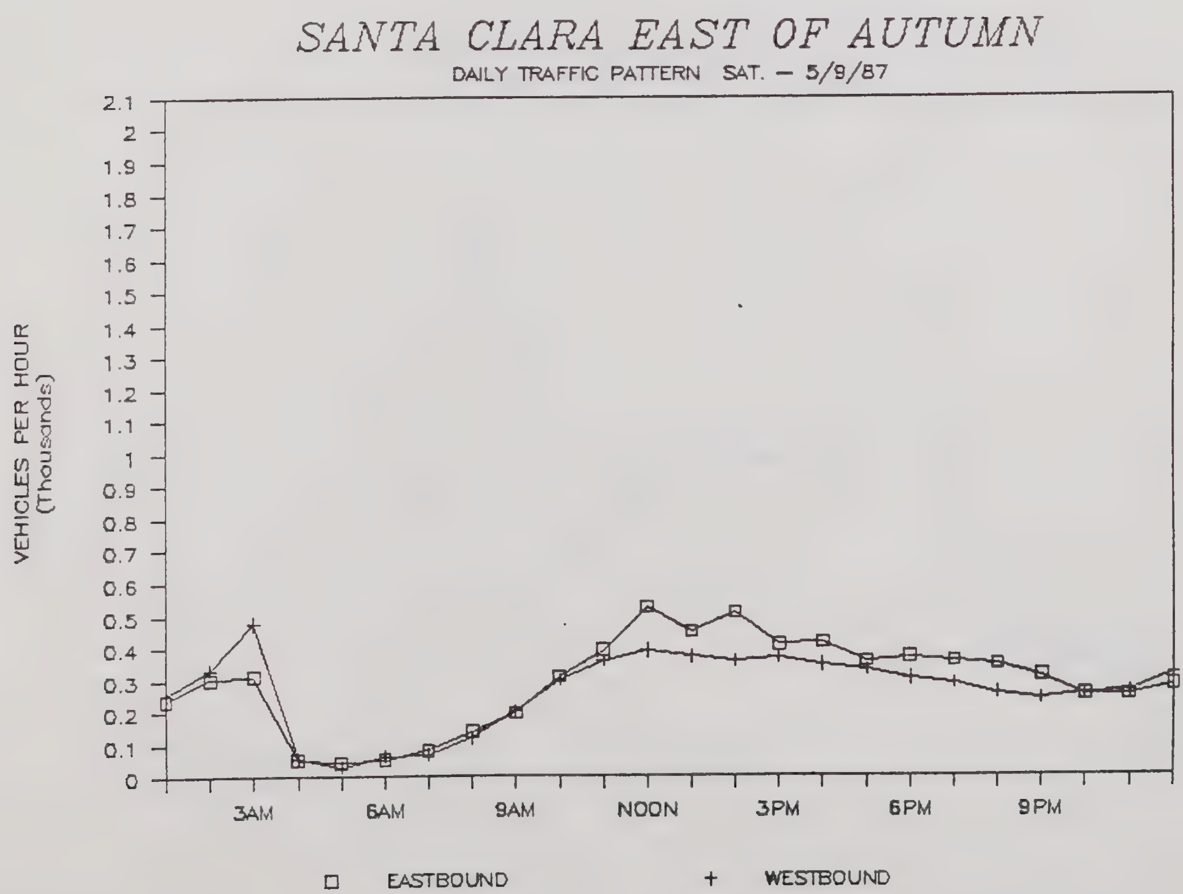


Figure-11

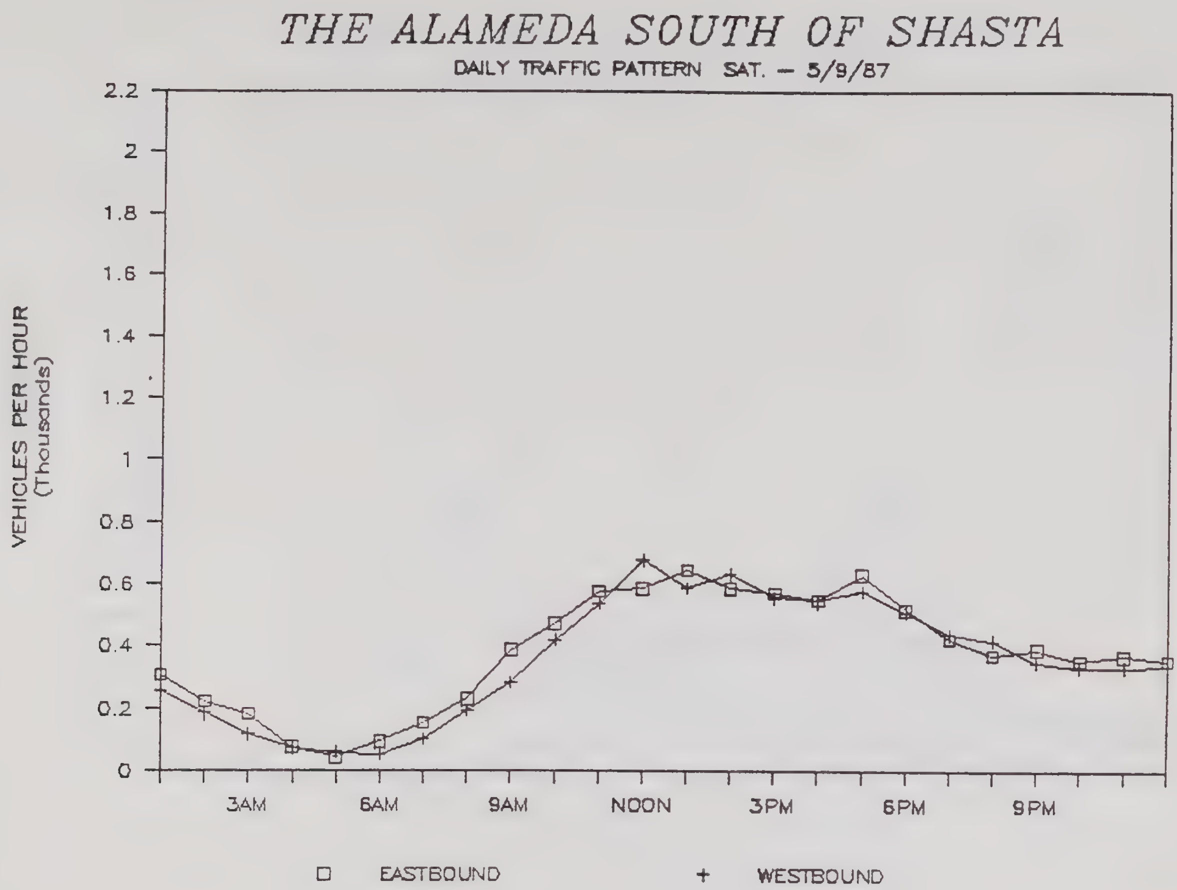


Figure-14

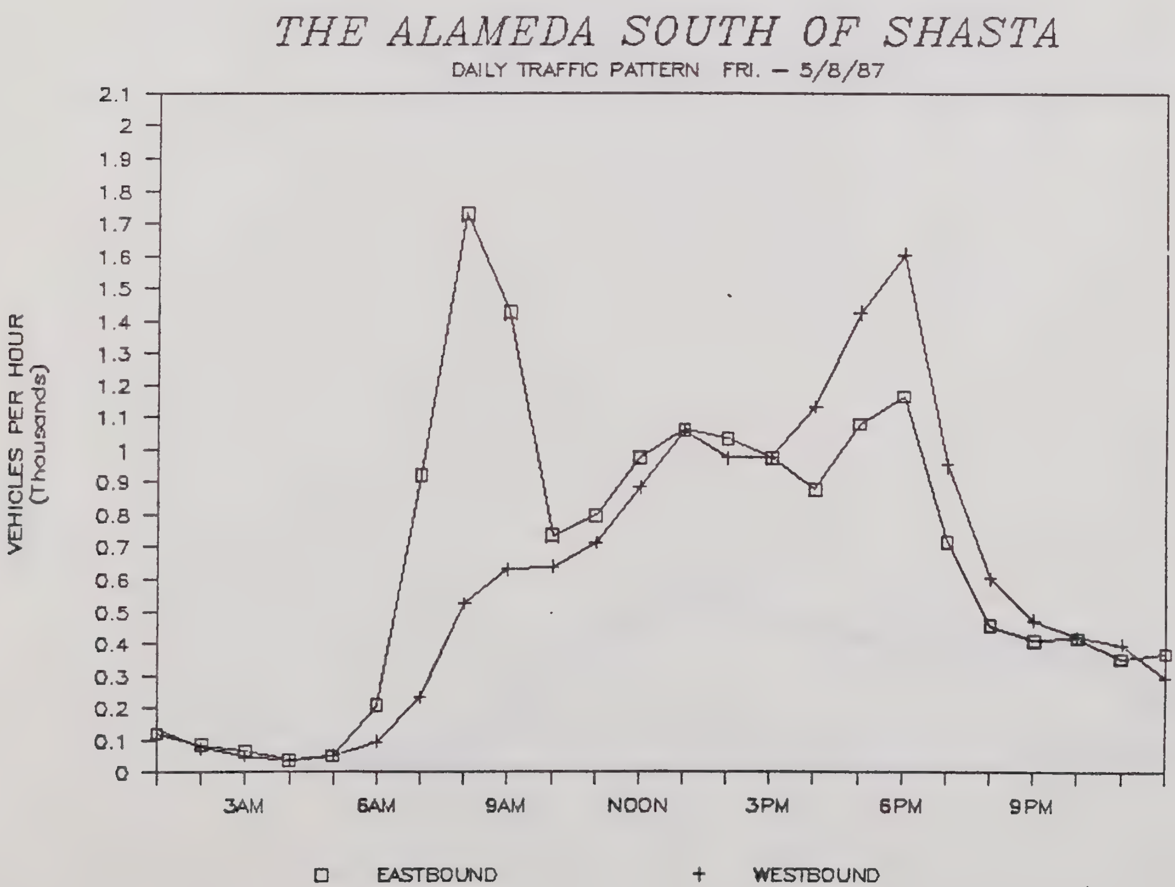


Figure-13

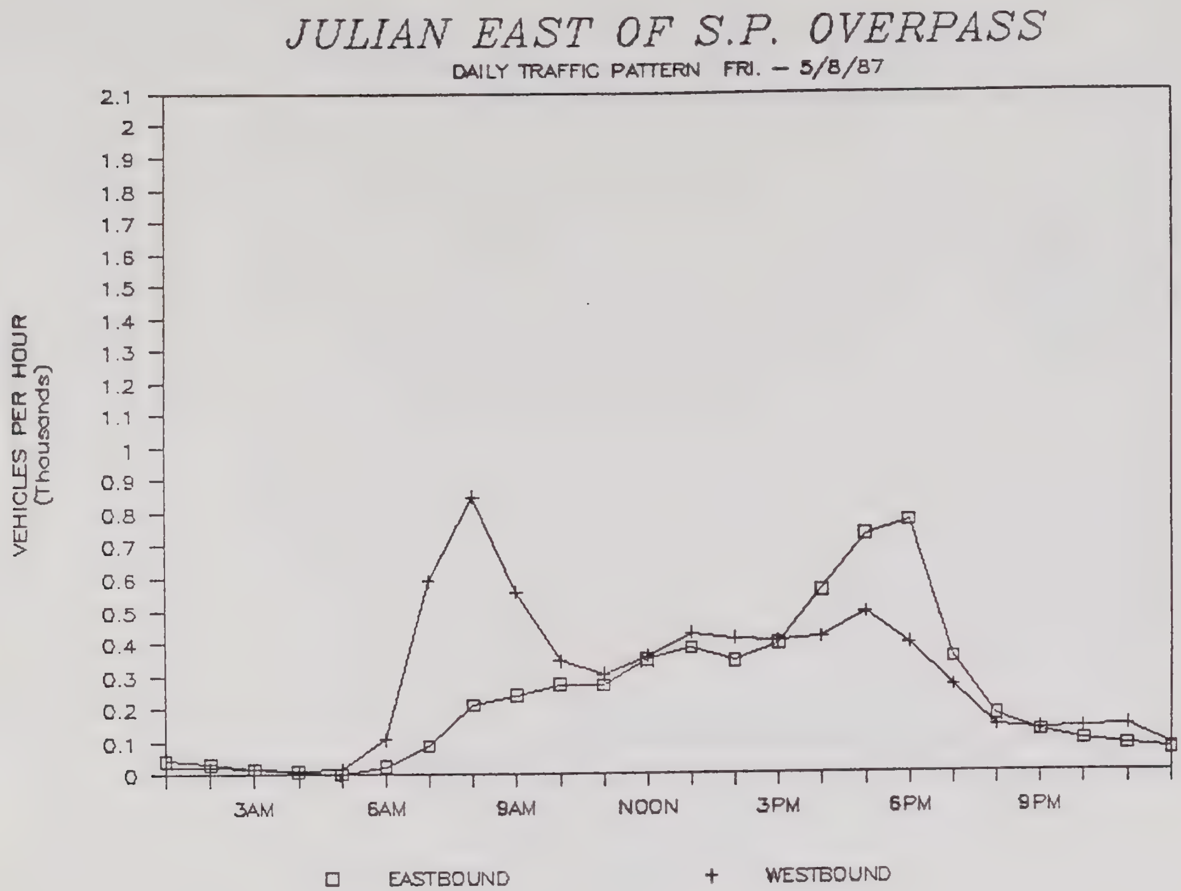


Figure-16

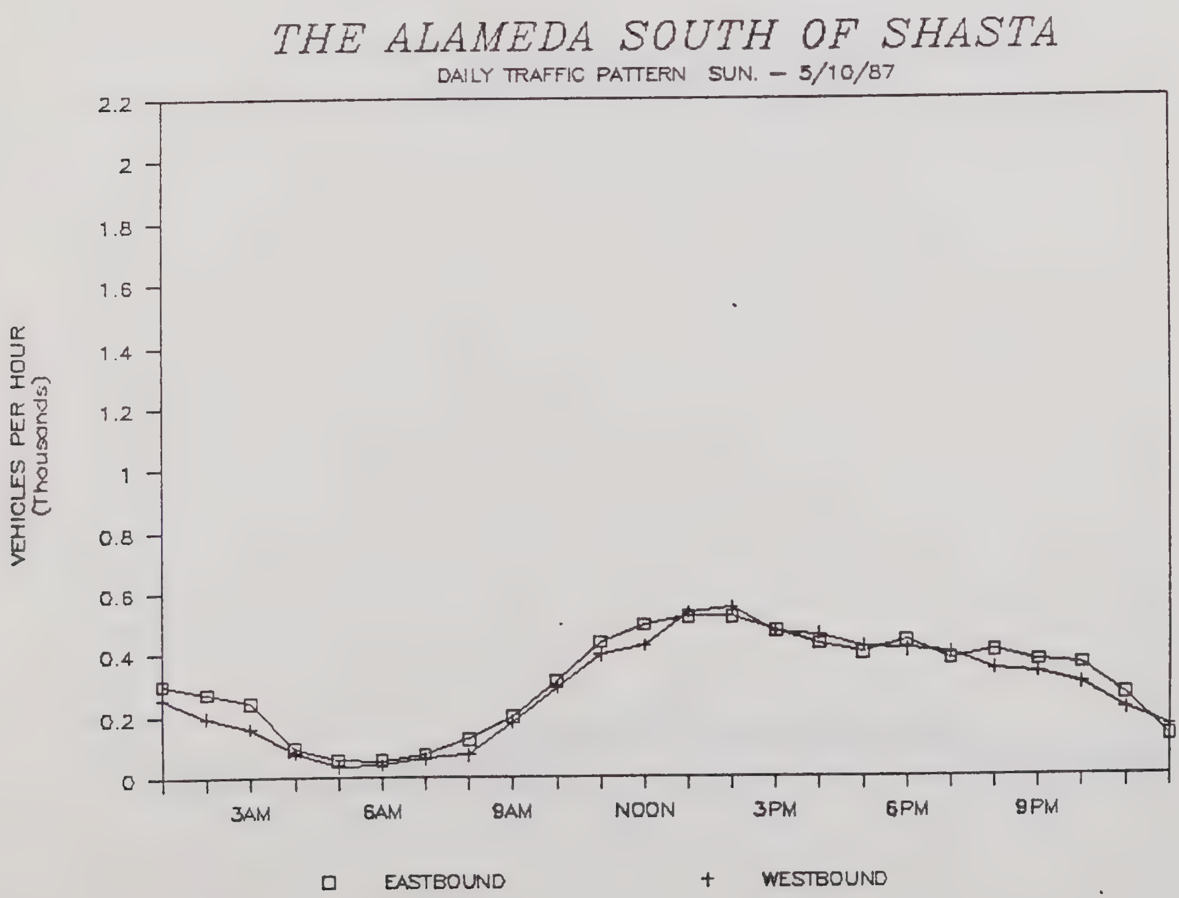


Figure-15

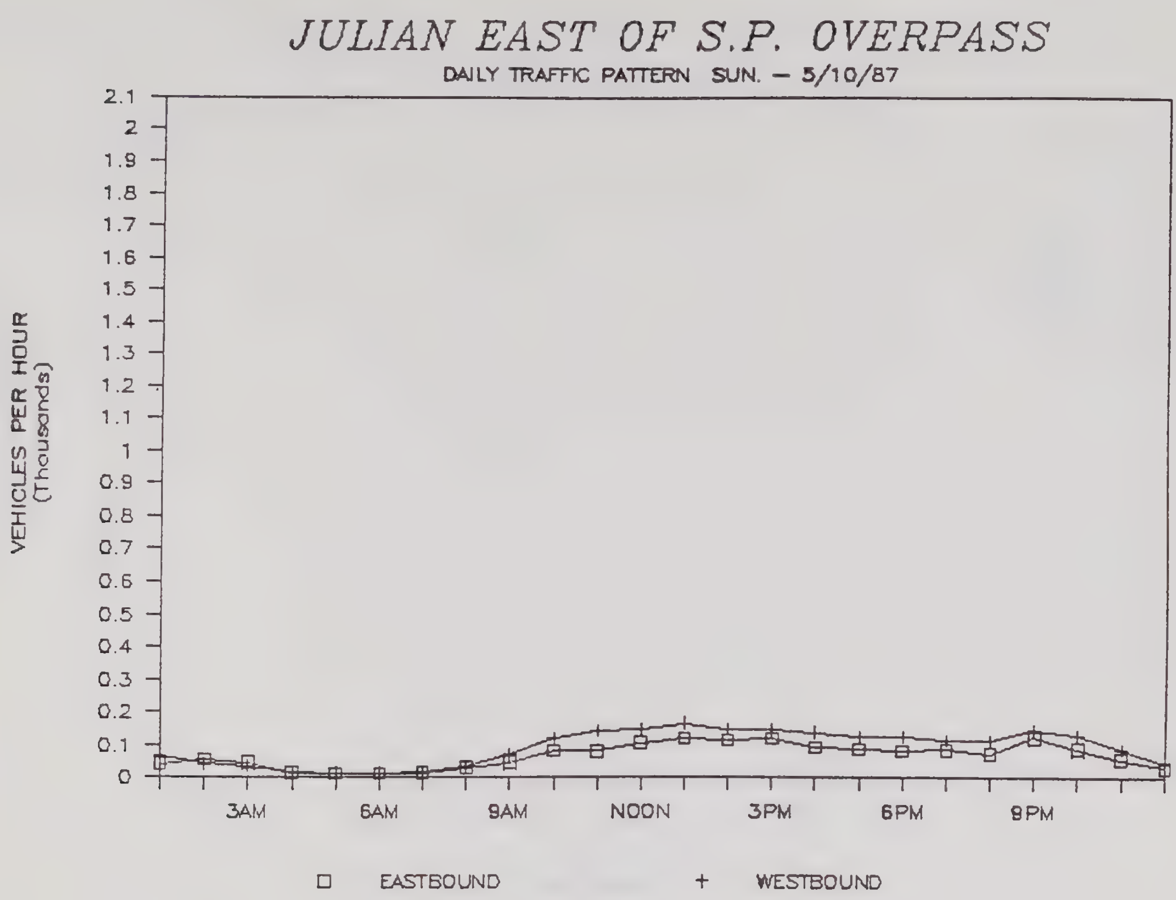


Figure-18

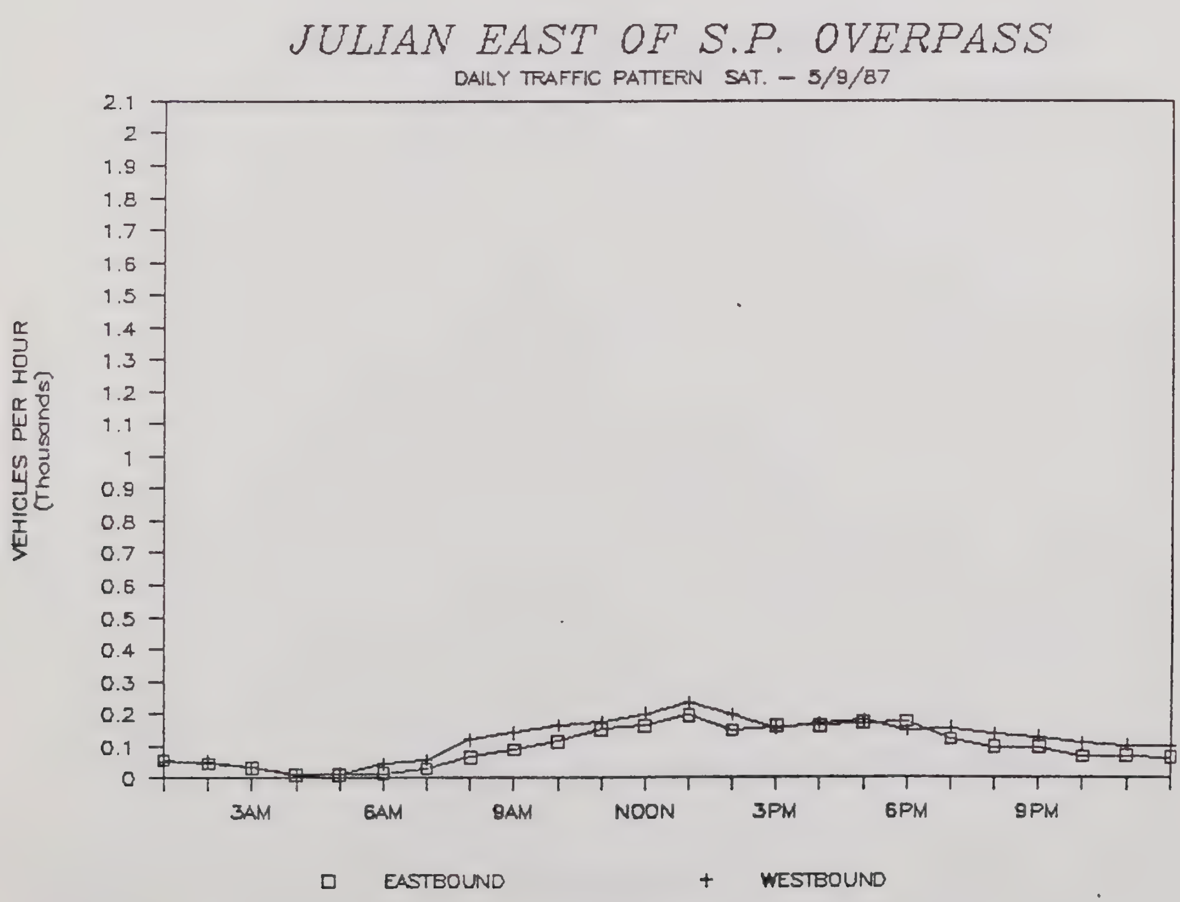


Figure-17

SHASTA WEST OF THE ALAMEDA

DAILY TRAFFIC PATTERN SAT. – 5/9/87

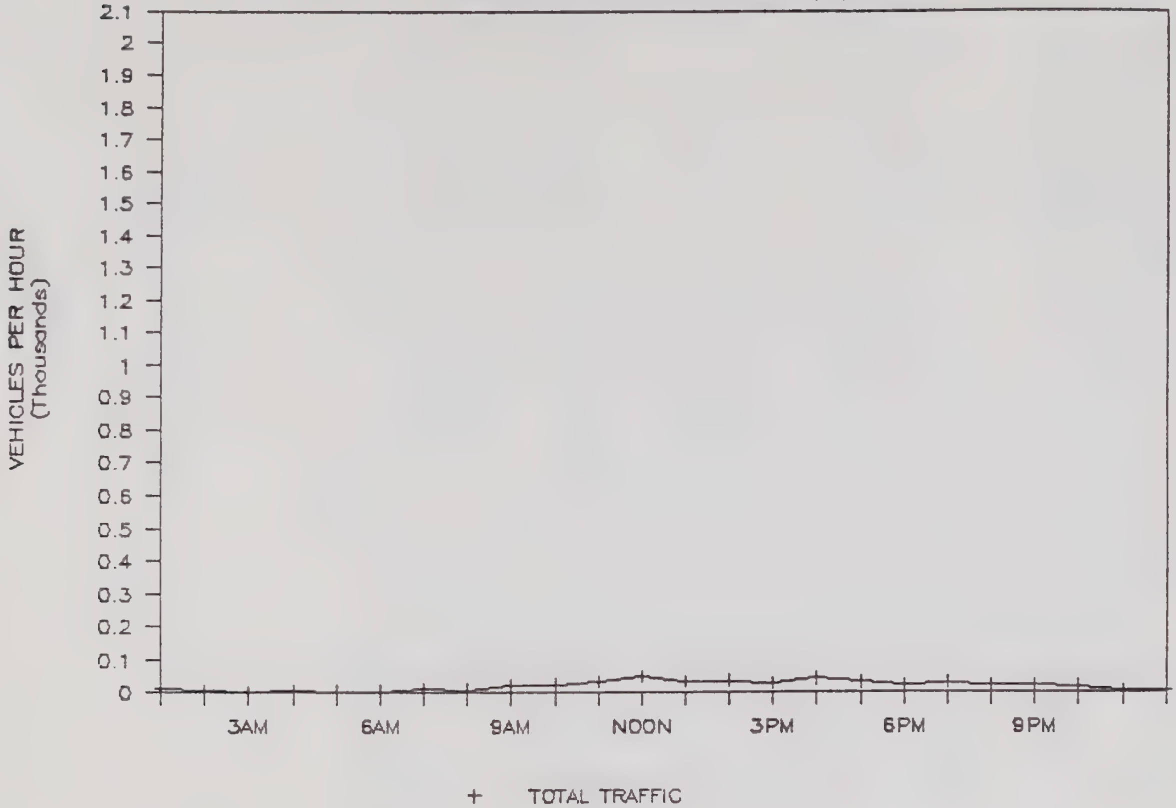


Figure-20

SHASTA WEST OF THE ALAMEDA

DAILY TRAFFIC PATTERN FRI. – 5/8/87

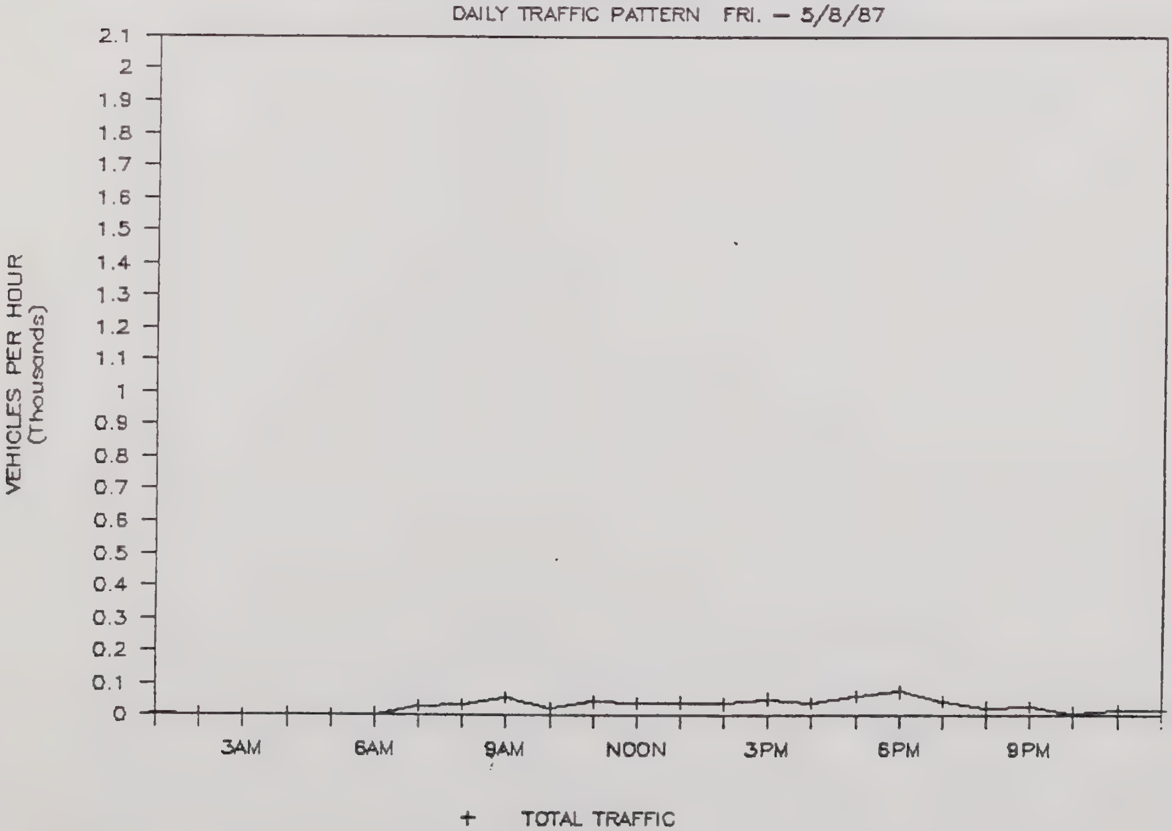


Figure-19

HANCHETT WEST OF THE ALAMEDA

DAILY TRAFFIC PATTERN SAT. – 5/9/87

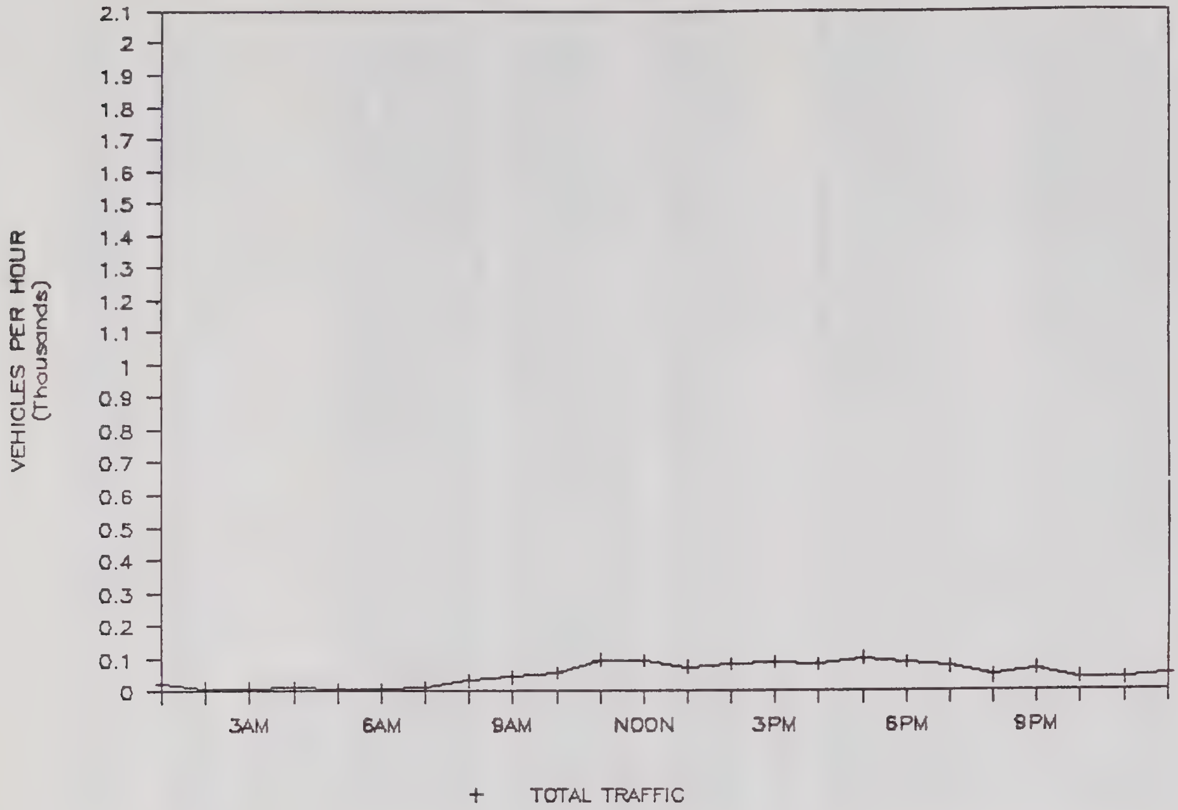


Figure-22

HANCHETT WEST OF THE ALAMEDA

DAILY TRAFFIC PATTERN FRI. – 5/8/87

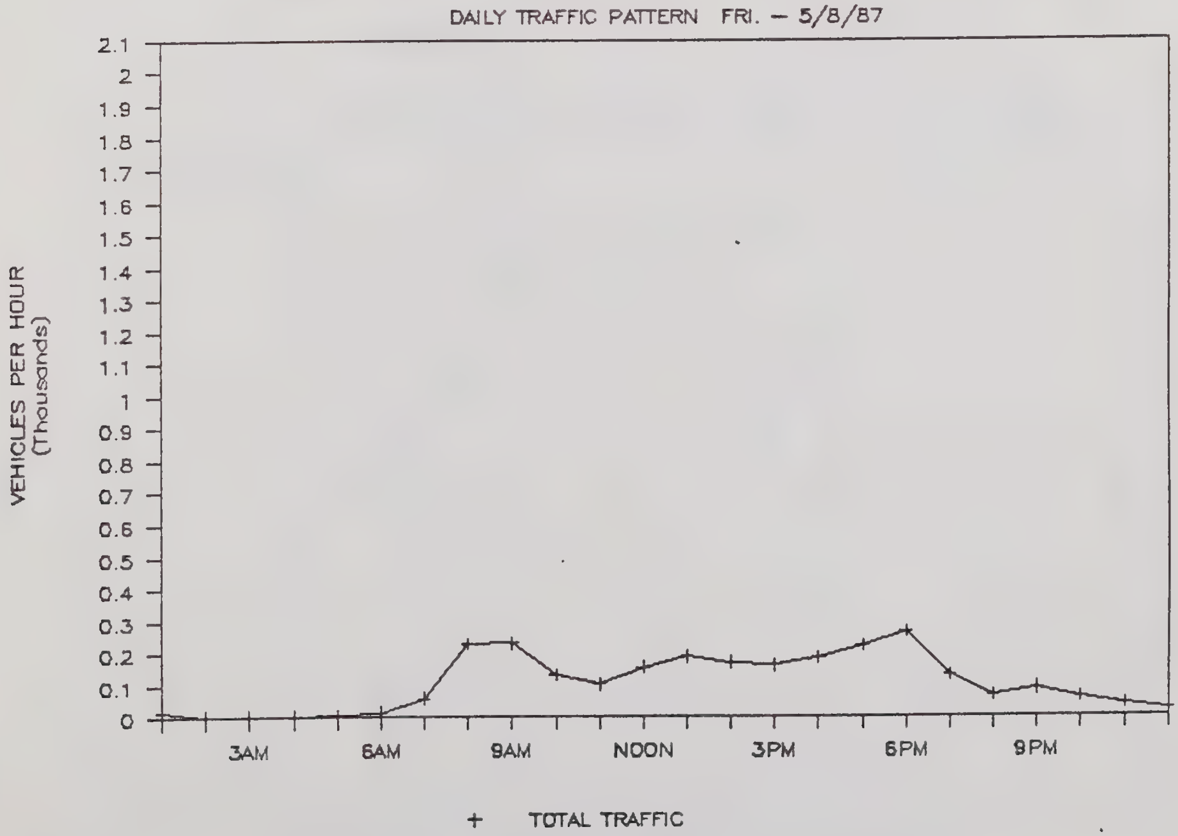


Figure-21

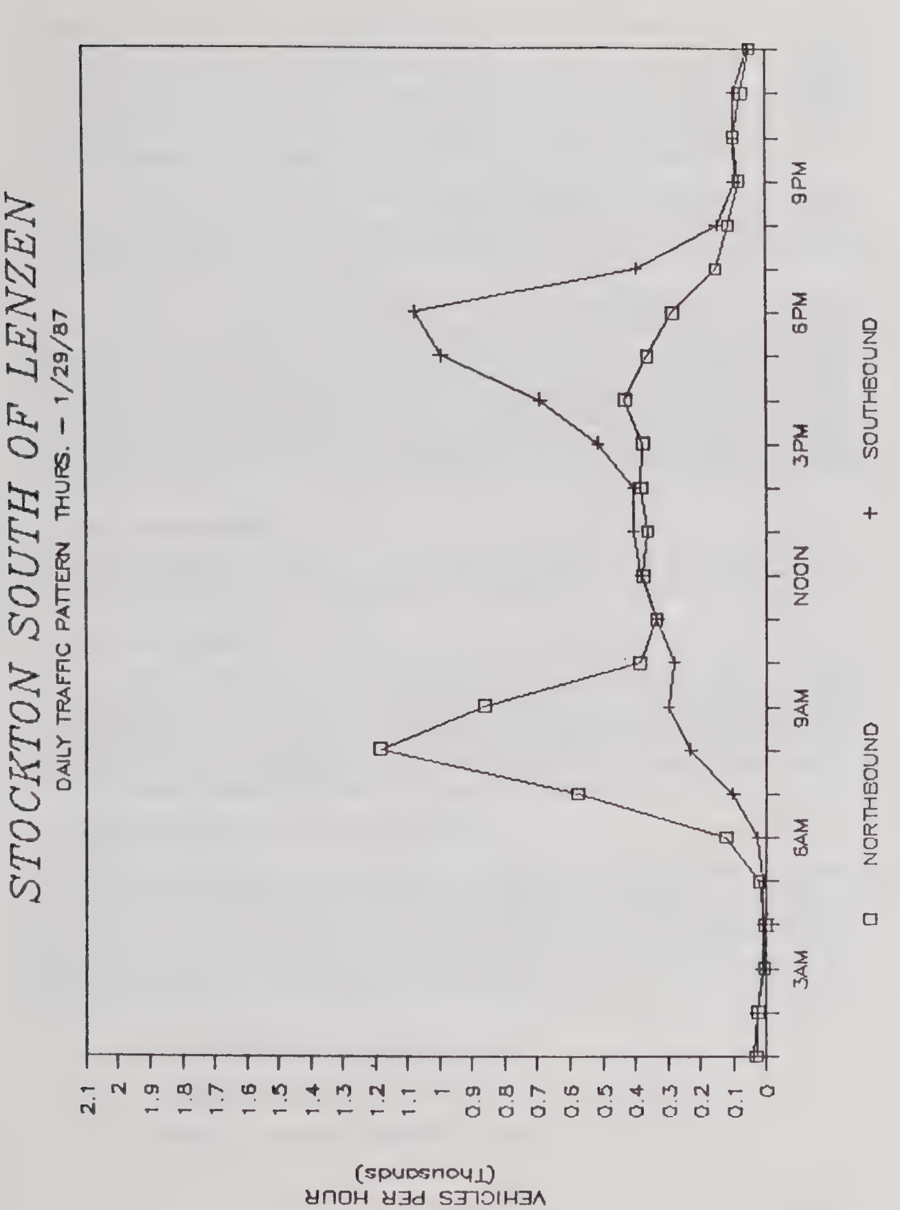


Figure-23

commuter travel on weekdays during the AM and PM peak periods. These commute patterns are reflected in the h gh peaks on the graph. The same street on Saturday and Sunday have a low steady traffic flow all day without any peaks.

Similarly, due to the local character of residential streets, they generally carry low volumes and less commuter trips. The graphs in these cases are flat and do not show high peaks.

Transit Services

CalTrain Service:

Currently, the CalTrain commuter rail system operating between San Francisco and San Jose terminates at the Cahill station located just south of Santa Clara Street. On weekdays 27 trains operate from San Francisco to San Jose and 26 trains operate from San Jose to San Francisco. The weekday service runs between 5 AM and 10 PM for both the northbound and southbound directions. On Saturdays, twelve trains operate in each direction; on Sundays, nine trains provide service. The majority of the trains stop at all the existing 27 stations along the Peninsula to pickup and discharge passengers.

Due to its close proximity to Site B, the Cahill station offers some opportunities to provide service for the arena patrons to and from the Peninsula cities. Also, during events, if demand dictates, it is possible to provide a special train service similar to the one now provided for events at the Stanford Stadium. Without major changes to the existing services, it was estimated that 2% of the arena patrons from the Peninsula Market area would use CalTrain service.

Studies are underway to investigate extending BART service to the South Bay. Although these studies are in the preliminary stages, it is likely that BART will be extended to San Jose. The Cahill station is a strong candidate for a BART station. However, for the traffic analysis BART usage by arena patrons was not assumed.

Light Rail Service:

The Guadalupe Light Rail (LRT) line is currently under construction. This LRT line will connect downtown San Jose with south San Jose and the City of Santa Clara. Several LRT stations are proposed in the downtown transit mall area. Site B would be located nearest to the station planned at the intersection of First Street and Saint James Street. In terms of walking time, Site B would be about 10 minutes away from the Saint James station, and 20 minutes away from another LRT station located at the intersection of First Street and Santa Clara Street.

Road System Improvements

Major transportation system improvements are planned for the area serving Site B. The Route 87/Guadalupe Parkway construction through Downtown San Jose is the major road improvement project currently underway and will be completed by mid to late 1988. As part of this construction project, Route 87 will be extended as a freeway between I-280 and West Taylor Street. According to the design plans, a northbound on-ramp and a southbound off-ramp will be constructed at Park Avenue. A northbound off-ramp will be constructed at West Santa Clara Street. A complete interchange will be constructed between Route 87 and Julian Street. Also, a

northbound on-ramp and a southbound off-ramp have been constructed at Coleman Avenue. Within the context of the Route 87 construction project a new street connection will be provided to connect Pleasant Street with Santa Teresa Street (under existing conditions, Santa Teresa is referred to as N. Almaden) from Julian to Santa Clara under Route 87. Once the freeway and its interchanges are completed, Delmas Avenue will be converted to one-way southbound between Santa Clara Street and Auzerais Avenue and will connect with a southbound on-ramp to Route 87.

The construction of Route 87 will not only add significant road capacity for regional connections to downtown, it will also enable the construction of 320 parking spaces underneath the structure south of Santa Clara Street. This parking resource would be available for Site B patrons due to its close proximity to the site.

The recently completed Guadalupe River Park Plan recommends a new roadway facility called River Front Road to be located west of and parallel to the Guadalupe River between Coleman Avenue and Santa Clara Avenue. This is proposed to be a four-lane roadway with signals at Coleman Avenue, Julian Street, and Santa Clara Street. This roadway has been adopted in the city's General Plan. However, at this time, it has not been funded; therefore, its time of completion is not known. With the completion of River Front Road, the existing Montgomery/Autumn one-way couplet between Santa Clara and Julian will be eliminated and will be replaced by River Front Road.

3.2 1991 Base Conditions

It is anticipated that 1991 is the year for the opening of the proposed arena development. Therefore, the traffic analysis was completed for Year 1991 conditions.

Intersection Operation

For the five scenarios studied, existing traffic volumes at the twenty critical intersections were factored by an annual growth rate of 1.2 percent to Year 1991. This growth rate reflects the annual increase in the regional background traffic anticipated between now and 1991. Also, the anticipated traffic volumes from future projects in the site vicinity which have been approved were added to the factored traffic volumes. This provided Year 1991 base traffic volumes.

Year 1991 (Base Conditions) Level of Service:

The results of the level of service calculations performed for Year 1991 base traffic conditions are summarized in Table 9. These traffic volumes do not include any project traffic. The purpose of analyzing Year 1991 base conditions is to determine the operating level of the studied intersections prior to the addition of the arena-generated traffic for **Year 1991**. The number of intersections which would operate under unacceptable conditions for each of the time scenarios analyzed are provided below:

— Weekday PM peak hour: 6 intersections

— Weekday Evening peak hour: None

— Weekday Late Evening peak hour: None

TABLE 9
1991 BASE CONDITION INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM		WKDY EVE.		WKDY LATE EVE.		FRI. EVE.		SAT. EVE.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C
Alameda & Taylor/Naglee	E	.992	A	.320	A	.149	B	.600		N.A. /c/
Stockton & Taylor	A	.517	A	.122	A	.060	A	.287		N.A.
Coleman & Taylor	D	.842	A	.139	A	.098	A	.294		N.A.
S.R. 87 & Taylor	D	.813	A	.361	A	.137	A	.484		N.A.
S.R. 87 Off-Ramp (SB) & Coleman	A	.779	A	.578	A	.156	A	.514		N.A.
San Pedro & Julian	E/d/		C		A		E		A	
Market & Julian	E	.942	A	.430	A	.196	A	.449	A	.314
Alameda & Julian/Hanchett	D	.838	A	.310	A	.154	A	.459	A	.283
Stockton & Julian	F	1.118	A	.285	A	.200	A	.549	A	.253
Montgomery & Julian	C	.716	A	.159	A	.078	A	.375		
S.R. 87 On-Ramp (SB) & Julian	A	.344	A	.217	A	.088	A	.266	A	.139
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	C	.707	A	.352	A	.076	A	.262	A	.145
Alameda/Race & Martin	D	.840	A	.290	A	.136	A	.425	A	.237
Stockton & Alameda	F/d/		A		A		A			N.A.
Cahill & Alameda	C	.709	A	.269	A	.129	A	.344		N.A.
Montgomery & Alameda	A	.583	A	.261	A	.140	A	.346	A	.248
Autumn & Santa Clara	A	.376	A	.154	A	.087	A	.222	A	.126
S.R. 87 Off-Ramp (NB) & Santa Clara	A	.431	A	.206	A	.095	A	.267	A	.139
Santa Teresa (N. Almaden) & Santa Clara	E	.976	A	.337	A	.212	A	.515	A	.288
Notre Dame & Santa Clara	C	.733	A	.272	A	.165	A	.461	A	.265

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections

— Friday Evening peak hour: 1 intersection

— Saturday Evening peak hour: None.

The results indicate that two of the six intersections that will operate under unacceptable conditions are not under signal control. The other four intersections will operate under LOS E or F conditions during the PM peak hour. The remaining intersections will all be operating at LOS D or better for all the time scenarios. In fact, with the exception of one intersection (Julian and San Pedro), all other intersection locations will be operating at Level of Service A or B during the evening peak hours. This indicates ample spare capacity will be available to serve arena project traffic during those times.

3.3 Year 1991 Base Plus Project Conditions

In this study analyses were conducted for two different seating capacities: 17,500 seats and 20,000 seats. For both cases, maximum attendance was assumed.

Trip Generation

The arena trip generation estimates for each of the two seating capacities are given in Table 10. These numbers are based on the following assumptions:

- Estimated Transit use: 1% by buses, 2% of Peninsula residents by CalTrain, 5% of south San Jose residents by the Guadalupe LRT line.
- An average of 3.0 persons per car.
- The arena events will start at 7:30 PM.
- About 4% of the patrons will arrive during the PM peak hour.
- An estimated 93% will arrive between 6:30 PM and 7:30 PM.
- An estimated 93% of the patrons will leave the arena during the hour immediately after the event.

TABLE 10
TRIP GENERATION FOR ARENA

Site	Average Peak Attendance	Transit (Person Trips)	Automobile (Vehicle Trips)
B	17,500	525	5,660
B	20,000	600	6,470

The traffic analysis is based on the assumption that 97% of the arena patrons would arrive by car and would park at the available parking facilities within an acceptable walking distance from Site B.

Automobile Trip Distribution and Assignment

Year 1995 projected population statistics for the South Bay area were used to determine the market area for the arena sites. The economic consultants[4] provided the projected population for each geographic segment of the market area. The population information was extracted from Year 1985 projections produced by the Association of Bay Area Governments. The automobile trip distribution was based on the percentages shown on Figure 24, which gives the percentage of the total arena trips estimated to use each of the regional facilities. The majority of the arena patrons is expected to use regional freeway facilities for obtaining access to the site area. However, in this study it was assumed that some traffic would use the local facilities. An estimated 5% of the project traffic was assigned on the Alameda, 7% on Coleman Avenue, 2% on Julian Street/St. James Street, 2% on Santa Clara Street, 5% on Market Street, 1% on Almaden Boulevard, 1% on Autumn/Montgomery, 1% on Race Street, 1% on Hanchett Avenue, and 2% on Naglee Avenue.

The estimated automobile trips were distributed and assigned to the regional and local roadways approaching the proposed arena site. The trip assignments on the street system in the vicinity of the site were based on the parking facility locations and their walking distances to Site B. The details of this procedure are outlined in Chapter 2 under the Parking Section. The resulting PM peak, evening peak, and late evening peak hour traffic assignments were used to determine the traffic impact of the arena project.

Intersection Operation

Year 1991 (with Project) Level of Service:

The intersection level of service calculation results for both seating capacities (i.e. 17,500 seats and 20,000 seats) with maximum attendance are presented in Tables 11 and 12. The number of intersections that would operate under unacceptable conditions is the same for both attendance levels. They are given below:

- Weekday PM peak hour: 12 intersections (for 17,500 persons attendance level)
  13 intersections (for 20,000 persons attendance level)
- Weekday Evening peak hour: 1 intersection
- Weekday Late Evening peak hour: 2 intersection
- Friday Evening peak hour: 2 intersections
- Saturday Evening peak hour: 1 intersection

When these results are compared with the results from Year 1991 base conditions (without the arena traffic), it is observed that all six intersections would already operate under unacceptable conditions during the PM peak hour and one intersection

[4] Economics Research Associates

Barton-Aschman Associates, Inc.

Figure-24

DIRECTIONS OF APPROACH FOR SITE "B"

TABLE 11
1991 WITH PROJECT (CAPACITY: 17,500 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	F	1.068	A	.435	A	.231	B	.605		N.A. /c/
Stockton & Taylor	A	.530	A	1.122	A	.071	A	.287		N.A.
Coleman & Taylor	E	.926	A	.187	A	.242	A	.390		N.A.
S.R. 87 & Taylor	F	1.097	B	.689	A	.137	C	.795		N.A.
S.R. 87 Off-Ramp (SB) & Coleman	F	1.124	C	.706	A	.242	B	.639		N.A.
San Pedro & Julian	F/d/		F		F		F		F	
Market & Julian	F	1.258	A	.522	A	.265	A	.541	A	.396
Alameda & Julian/Hanchett	E	.948	A	.450	A	.235	B	.607	A	.418
Stockton & Julian	F	1.274	A	.442	A	.429	C	.706	A	.411
Montgomery & Julian	D	.801	B	.680	F	1.121	C	.795		N.A.
S.R. 87 On-Ramp (SB) & Julian	D	.898	B	.664	A	.421	D	.712	B	.670
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	F	1.028	B	.623	C	.753	A	.534	A	.457
Alameda/Race & Martin	D	.862	A	.373	A	.164	A	.448	A	.341
Stockton & Alameda	F/d/		A		A		A			
Cahill & Alameda	C	.770	A	.335	A	.230	A	.409		N.A.
Montgomery & Alameda	B	.644	A	.327	A	.222	A	.410	A	.315
Autumn & Santa Clara	A	.442	A	.220	A	.192	A	.288	A	.192
S.R. 87 Off-Ramp (NB) & Santa Clara	C	.787	A	.546	A	.348	B	.608	A	.460
Santa Teresa (N. Almaden) & Santa Clara	F	1.454	D	.810	A	.387	E	.990	C	.761
Notre Dame & Santa Clara	F	1.097	B	.654	A	.443	D	.845	B	.646

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections

TABLE 12
1991 WITH PROJECT (CAPACITY: 20,000 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM		WKDY EVE.		WKDY LATE EVE.		FRI. EVE.		SAT. EVE.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C
Alameda & Taylor/Naglee	F	1.076	A	.452	A	.244	B	.605		N.A. /c/
Stockton & Taylor	A	.542	A	.122	A	.071	A	.287		N.A.
Coleman & Taylor	E	.930	A	.203	A	.264	A	.397		N.A.
S.R. 87 & Taylor	F	1.132	C	.733	A	.137	D	.836		N.A.
S.R. 87 Off-Ramp (SB) & Coleman	F	1.158	C	.712	A	.248	B	.646		N.A.
San Pedro & Julian	F/d/		F		F		F		F	
Market & Julian	F	1.279	A	.531	A	.270	A	.547	A	.401
Alameda & Julian/Hanchett	E	.964	A	.461	A	.251	B	.621	A	.431
Stockton & Julian	F	1.288	A	.456	A	.462	C	.720	A	.424
Montgomery & Julian	D	.807	C	.742	F	1.149	D	.869		N.A.
S.R. 87 On-Ramp (SB) & Julian	E	.981	C	.788	A	.466	D	.833	C	.724
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	F	1.128	C	.710	C	.779	B	.637	A	.554
Alameda/Race & Martin	D	.863	A	.393	A	.168	A	.495	A	.361
Stockton & Alameda	F/d/		A		A		A			
Cahill & Alameda	C	.783	A	.351	A	.267	A	.425		N.A.
Montgomery & Alameda	D	.885	B	.635	A	.257	C	.734	B	.617
Autumn & Santa Clara	A	.457	A	.235	A	.221	A	.303	A	.206
S.R. 87 Off-Ramp (NB) & Santa Clara	D	.839	A	.596	A	.371	B	.659	A	.509
Santa Teresa (N. Almaden) & Santa Clara	F	1.471	D	.827	A	.478	F	1.007	C	.778
Notre Dame & Santa Clara	F	1.098	B	.656	A	.562	D	.849	B	.648

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed
/d/ Worst Approach Level of Service For Stop-Controlled Intersections

during the evening peak hours. The remaining intersections would deteriorate to LOS E and F conditions with the addition of the arena traffic.

According to the City of San Jose policy, the traffic impact of a project at an intersection is considered significant and therefore will require mitigation(s) if either one of two following conditions occur:

1. The level of service of an intersection deteriorates from an acceptable level (LOS A, B, C, or D) to an unacceptable level (LOS E or F) after the addition of the project traffic, or

2. For an intersection operating at an unacceptable level of service prior to the addition of the project traffic, the proposed project increases the critical base condition traffic volumes by 1% or more.

PM Peak Hour

Among the five time scenarios considered the PM peak hour is the most critical. This condition would occur at most two or three times a year when the arena events are broadcasted to a nationwide audience.

In this scenario, 93% of the arena traffic is projected to arrive at Site B during the peak PM commute hour. For this reason 12 intersections would operate at LOS E or F for the condition with maximum attendance of 17,500 persons, and 13 intersections for the condition with maximum attendance of 20,000 persons. Based on the city's Level of Service Policy, all of these intersections would be significantly impacted by the arena project and would require mitigation measures, where possible.

Mitigation measures for these intersections are discussed in Section 3.6.

Evening Peak Hour

In general, the traffic conditions in the site vicinity are worse on a Friday evening than on a typical weekday or Saturday evening. The intersection of San Pedro and Julian which would operate under unacceptable conditions during the weekday and Saturday evening peak hours is projected to deteriorate even more on Friday evenings. This is because of the increased activity level of the general area during weekend evenings. The intersection of Santa Teresa and Santa Clara would operate under unacceptable conditions (LOS F with V/C = 1.007) on Friday evenings. The Center for Performing Arts, Montgomery Theatre, and Civic Auditorium are all located in the vicinity of that intersection.

Potential mitigation measures to improve the intersection operations are discussed in Section 3.6.

Late Evening Peak Hour

Due to the relatively low base traffic volumes on the roadways during this time period the operations of almost all the intersections included in this traffic analysis are well above the minimum acceptable standards, even with 93% of the arena traffic leaving the site within the hour after the end of the event. The only exceptions would occur at the intersections of Montgomery and Julian and San Pedro and Julian.

Potential mitigation measures to improve these intersections are discussed in Section 3.6.

3.4 Year 2000 Base Conditions

The traffic impact analysis for the Year 2000 was conducted to determine the long term impact of the arena project. An analysis of this type requires a reliable long range forecast of background traffic.

The City of San Jose has developed and calibrated a travel demand model for the Year 2000. This model was used for forecasting the PM peak hour traffic volumes for the city streets. This model is known as the HORIZON 2000 TRANPLAN model.

This model is based on the TRANPLAN computer software package, which is commonly used for traffic simulation studies for large urban areas such as the City of San Jose. The City's model is a sophisticated analytical tool with more than 600 traffic analysis zones and thousands of network links. It generates, distributes and assigns nearly 500,000 all purpose trips to the road system network for the PM peak hour. During the assignment process this model accounts for traffic congestion by assigning trips so as to minimize travel time on the road network, but also takes into consideration the available road system capacity. Major planning assumptions built into the model for the Year 2000 include the following:

- Calibration of model using Year 1980 census data.
- Year 2000 data generally matched the ABAG 2005 projections.
- Full built-out of the Julian/Stockton Area with 8,000 jobs.
- Full built-out of North San Jose by Year 2000.
- Completion of the following transportation system projects.
  - Construction of Route 87 as a freeway from south San Jose to north of Taylor Street.
  - Expansion of I-280 to 8 lanes from I-880 to Magdalena Avenue.
  - Widening of I-880 to 6 lanes north of U.S. 101.
  - Modification of Route 237 to provide 8 lanes (6 lanes plus 2 auxiliary lanes).
  - Construction of River Front Road between Coleman Road and Santa Clara Street.
- Increased diversion to transit and carpools, with an expanded countywide HOV lane program, which includes I-280, U.S. 101 and Route 237, San Tomas Expressway, Capital Expressway, Montague Expressway, Lawrence Expressway, and Central Expressway.

The city's traffic model, described above, was utilized for estimating the Year 2000 base traffic volumes in the vicinity of Site B. The model run used assumed that the Julian/Stockton area will be redeveloped with Research and Development, and office type of land uses. This model run assumed no development(s) on Site B.

Different factors were applied to the PM peak hour traffic volumes produced by the city's traffic model for projections of traffic volumes during the other time periods under study. These peak hour factors were developed from the twenty-four hour machine counts taken along various roadway facilities in the project area.

Intersection Operation

Year 2000 (Base Condition) Level of Service:

The projected operation of the intersections in the vicinity of the site is described in Table 13.

The number of intersections that would operate under unacceptable conditions for each of the time scenarios analyzed are as follows.

- Weekday PM peak hour: 5 intersections
- Weekday Evening peak hour: 1 intersection
- Weekday Late Evening peak hour: None
- Friday Evening peak hour: 1 intersection
- Saturday Evening peak hour: None

PM Peak Hour

By Year 2000, even without the arena project, the intersection of S.R. 87 and Taylor would operate at a LOS F (with a V/C ratio = 2.1). This intersection would require major modifications for an efficient and acceptable level of operation. Potential mitigation measures that should be considered, regardless of the status of the arena project, are discussed in Section 3.6.

The other four intersections projected to operate under unacceptable conditions are:

1. Alameda & Julian/Hanchett
2. Stockton and Julian
3. River Front & Julian
4. Santa Teresa & Santa Clara

3.5 Year 2000 Base Plus Project Conditions

The traffic impacts of the arena project on Year 2000 base traffic conditions were determine for the two attendance levels studied.

Intersection Operation

Year 2000 (With Project) Level of Service:

The intersection level of service calculation results for both seating capacities (i.e. 17,500 seats and 20,000 seats) with maximum attendance are presented in Tables 14 and 15.

TABLE 13
YEAR 2000 BASE CONDITION INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	C	.749	A	.492	A	.183	A	.482		N.A. /c/
Stockton & Taylor	B	.641	A	.446	A	.207	A	.465		N.A.
Coleman & Taylor	D	.828	A	.253	A	.255	A	.547		N.A.
S.R. 87 & Taylor	F	2.098	F	1.316	A	.539	F	1.316		N.A.
River Front & Coleman	A	.482	A	.321	A	.152	A	.321	A	.201
S.R. Off-Ramp (SB) & Coleman	A	.380	A	.253	A	.120	A	.253		N.A.
San Pedro & Julian	N.A.		N.A.		N.A.		N.A.		N.A.	
Market & Julian	C	.751	A	.477	A	.216	A	.477	A	.289
Alameda & Julian/Hanchett	F	1.000	A	.538	A	.213	A	.565	A	.302
Stockton & Julian	E	.943	A	.370	A	.145	A	.446	A	.228
River Front & Julian	F	1.093	A	.515	A	.174	A	.596	A	.298
S.R. 87 On-Ramp (SB) & Julian	A	.577	A	.352	A	.166	A	.360	A	.220
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	A	.529	A	.332	A	.145	A	.300	A	.193
Alameda/Race & Martin	A	.095	A	.061	A	.028	A	.061	A	0.37
Stockton & Alameda	A	.566	A	.331	A	.138	A	.366		N.A.
Cahill & Alameda	N.A.		N.A.		N.A.		N.A.		N.A.	
Montgomery & Alameda	A	.526	A	.319	A	.155	A	.361	A	.214
River Front & Santa Clara	C	.798	A	.493	A	.236	A	.538	A	.322
S.R. 87 Off-Ramp (NB) & Santa Clara	A	.390	A	.237	A	.115	A	.267	A	.159
Santa Teresa (N. Almaden) & Santa Clara	F	1.096	B	.653	A	.299	A	.746	A	.412
Notre Dame & Santa Clara	B	.609	A	.377	A	.167	A	.434	A	.225

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed

TABLE 14
2000 WITH PROJECT (CAPACITY: 17,500 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	D	.835	B	.619	A	.283	B	.610		N.A. /c/
Stockton & Taylor	C	.715	A	.460	A	.207	A	.477		N.A.
Coleman & Taylor	E	.945	B	.669	A	.285	B	.669		N.A.
S.R. 87 & Taylor	F	1.885	F	1.524	A	.539	F	1.524		N.A.
River Front & Coleman	C	.714	A	.546	A	.320	A	.546	A	.421
S.R. 87 Off-Ramp (SB) & Coleman	A	.476	A	.347	A	.120	A	.347		N.A.
San Pedro & Julian	N.A.		N.A.		N.A.		N.A.		N.A.	
Market & Julian	E	.931	A	.534	A	.222	A	.534	A	.346
Alameda & Julian/Hanchett	F	1.059	B	.669	A	.303	B	.688	A	.362
Stockton & Julian	F	1.095	B	.636	A	.360	C	.734	A	.458
River Front & Julian	F	1.858	F	1.460	D	.803	F	1.506	F	1.161
S.R. 87 On-Ramp (SB) & Julian	E	.944	C	.776	A	.520	C	.776	B	.648
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	E	.919	B	.670	D	.871	B	.670	A	.475
Alameda/Race & Martin	A	.553	A	.401	A	.125	A	.392	A	.252
Stockton & Alameda	B	.624	A	.390	A	.194	A	.424		N.A.
Cahill & Alameda	N.A.		N.A.		N.A.		N.A.		N.A.	
Montgomery & Alameda	A	.590	A	.387	A	.155	A	.428	A	.285
River Front & Santa Clara	F	1.012	C	.719	A	.350	C	.763	A	.568
S.R. 87 Off-Ramp (NB) & Santa Clara	B	.653	A	.517	A	.367	A	.517	A	.455
Santa Teresa (N. Almaden) & Santa Clara	F	1.647	F	1.203	A	.484	F	1.245	E	.960
Notre Dame & Santa Clara	E	.932	B	.664	A	.455	B	.724	A	.501

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed

TABLE 15
2000 WITH PROJECT (CAPACITY: 20,000 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	WKDY PM LOS/a/	WKDY PM V/C/b/	WKDY EVE. LOS	WKDY EVE. V/C	WKDY LATE EVE. LOS	WKDY LATE EVE. V/C	FRI. EVE. LOS	FRI. EVE. V/C	SAT. EVE. LOS	SAT. EVE. V/C
Alameda & Taylor/Naglee	D	.851	B	.632	A	.297	B	.624	N.A. /c/	
Stockton & Taylor	C	.720	A	.461	A	.207	A	.479	N.A.	
Coleman & Taylor	E	.960	B	.686	A	.304	B	.686	N.A.	
S.R. 87 & Taylor	F	1.879	F	1.530	A	.539	F	1.530	N.A.	
River Front & Coleman	C	.744	A	.575	A	.349	A	.575	A	.449
S.R. 87 Off-Ramp (SB) & Coleman	A	.476	A	.347	A	.120	A	.347	N.A.	
San Pedro & Julian	N.A.		N.A.		N.A.		N.A.		N.A.	
Market & Julian	E	.938	A	.540	A	.222	A	.540	A	.351
Alameda & Julian/Hanchett	F	1.083	B	.692	A	.318	C	.711	A	.413
Stockton & Julian	F	1.109	B	.648	A	.372	C	.744	A	.470
River Front & Julian	F	1.859	F	1.464	D	.859	F	1.505	F	1.290
S.R. 87 On-Ramp (SB) & Julian	F	1.041	D	.875	A	.564	D	.875	C	.751
S.R. 87 On-Ramp (NB)/Notre Dame & Julian	F	1.045	C	.759	E	.912	C	.773	A	.561
Alameda/Race & Martin	A	.571	A	.419	A	.129	A	.411	A	.271
Stockton & Alameda	B	.641	A	.408	A	.213	A	.442	N.A.	
Cahill & Alameda	N.A.		N.A.		N.A.		N.A.		N.A.	
Montgomery & Alameda	B	.605	A	.403	A	.155	A	.444	A	.301
River Front & Santa Clara	F	1.037	C	.757	A	.377	D	.801	B	.603
S.R. 87 Off-Ramp (NB) & Santa Clara	C	.741	A	.575	A	.389	B	.607	A	.513
Santa Teresa (N. Almaden) & Santa Clara	F	1.664	F	1.216	B	.614	F	1.312	E	.976
Notre Dame & Santa Clara	E	.950	B	.683	A	.538	C	.742	A	.520

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable or Not Analyzed

The number of intersections which would operate under unacceptable conditions are as follows:

- Weekday PM peak hour: 11 intersections
- Weekday Evening peak hour: 3 intersections
- Weekday Late Evening peak hour: none (for 17,500 persons attendance level)
  1 intersection (for 20,000 persons attendance level)
- Friday Evening peak hour: 3 intersections
- Saturday Evening peak hour: 2 intersections

When these results are compared with the results from Year 2000 base conditions (without the arena project), it is observed that all five intersections would already operate under unacceptable conditions during the PM peak hour and one intersection during the evening peak hours prior to the addition of the arena traffic through these intersections. The remaining intersections would deteriorate to LOS E or F conditions with the addition of the arena traffic.

PM Peak Hour

Up to 11 intersections would operate at LOS E or F during the PM peak hour. For all 11 intersections, the impacts of the arena traffic on the base conditions are considered significant by the city's Level of Service Policy.

Mitigations to improve their operations are discussed in Section 3.6.

Evening Peak Hour

The three intersections which would require modifications, with or without the arena project, to improve not only its PM peak hour operation but its evening peak hour operations as well include:

1. S.R. 87 and Taylor
2. River Front & Julian
3. Santa Teresa & Santa Clara

Mitigation measures to improve their operations are discussed in Section 3.6.

3.6 Transportation Mitigations

The required transportation-related improvements for Year 1991 and Year 2000 are outlined below by time scenarios. The intersections which could not be mitigated due to physical constraints are indicated as well.

Year 1991

PM Peak Hour:

1. Alameda and Taylor/Naglee Intersection

Under projected 1991 base conditions this intersection would operate at LOS E

(V/C = .992). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.076) for the maximum attendance level.

Under existing conditions, there exists two through lanes in both the northbound and southbound directions. It is recommended that the intersection be restriped and reconstructed to provide an additional lane in both directions. This would require parking prohibitions on both sides of Alameda and improve the projected LOS to D (V/C = .890).

2. Coleman and Taylor Intersection

This intersection is projected to operate at a level worse than D only for the maximum attendance level of 20,000 persons. For this condition, the intersection would operate at LOS E (V/C = .930).

Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection.

3. S.R. 87 and Taylor Intersection

Under projected 1991 base conditions, this intersection would operate at LOS D (V/C = .842). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.132) for the maximum attendance level.

It is recommended that this intersection be grade-separated with ramps constructed to permit all turning movements.

4. S.R. 87 Off-Ramp (SB) and Coleman Intersection

It is recommended that an additional through lane be added in both the eastbound and westbound directions, if feasible. This would improve the intersection operation to acceptable standards.

5. San Pedro and Julian Intersection

Currently this intersection is controlled with STOP signs for San Pedro traffic. Under existing conditions and Year 1991 PM peak hour traffic conditions, this intersection is and would continue to operate below LOS D if it remains unsignalized.

Due to its downtown location, this intersection is exempted from the City of San Jose's Level of Service Policy. Even so, it is recommended that a signal be installed at this intersection. Implementation of this mitigation measure would not only improve the operation of this intersection during the PM peak hour, but during the evening peak hours as well. Also, San Pedro should be realigned to improve visibility.

6. Market and Julian Intersection

Under projected 1991 base conditions, this intersection would operate at LOS E (V/C = .942). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.279) for the maximum attendance level.

Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection.

7. The Alameda and Julian/Hanchett Intersection

Under existing conditions, the Julian and Hanchett legs of this intersection are offset from one another. With the arena traffic included, the operation of this intersection would deteriorate from LOS D (V/C = .838) to LOS E (V/C = .964).

To improve the operation of this intersection during this time period, it is recommended that a barrier median be constructed on Alameda across its intersection with Hanchett. This barrier median extension will result in additional storage capacity for left-turning vehicles. Implementation of this mitigation measure will restrict the movements on Hanchett Avenue to include only right-turns in and out of this intersection. In addition, it is recommended that an island be constructed on the Hanchett leg. This will assist drivers and provide them with a clear indicator of the permitted movements.

Implementation of this improvement would improve the intersection operation to a LOS D (V/C = .852).

8. Stockton and Julian Intersection

Under projected 1991 base conditions, this intersection would operate at LOS F (V/C = 1.118). With the arena traffic included, the intersection operation would deteriorate to LOS F (V/C = 1.288) at maximum attendance level.

In order to improve the operation of this intersection during this time period, it would be necessary to reconstruct this intersection to provide the following lane geometrics:

north approach: an exclusive right-turn lane, an exclusive through lane, a shared through and left-turn lane, and an exclusive left-turn lane.

west approach: a shared through and right-turn lane and a shared through and left-turn lane.

Implementation of these mitigation measures would require land acquisition and the widening of the Julian underpass to provide a four-lane cross-section. With these improvements, the projected intersection LOS would improve from LOS F (V/C = 1.288) to LOS D (V/C = .831).

9. S.R. 87 On-Ramp (SB) and Julian Intersection

This intersection exempted from the City of San Jose's Level of Service Policy due to its downtown location. Even so, it is recommended that the north approach (i.e. southbound off-ramp) be widened to provide an additional shared through lane and left-turn lane. This would improve the intersection operation from LOS E (V/C = .981) to LOS D (V/C = .829). The off-ramp would have adequate storage space to accommodate the projected traffic volumes.

10. S.R. 87 On-Ramp (NB)/Notre Dame and Julian Intersection

This intersection is exempted from the City of San Jose's Level of Service Policy. With the arena traffic included, this intersection is projected to operate at LOS F (V/C = 1.128). For the two or three times during the year when events start at 6:00 PM the operation of this intersection would remain below acceptable standards. The maximum back of queue estimated for the off-ramp traffic extends 250 feet south of the nose of the off-ramp.

It is possible that the future PM peak hour traffic conditions at this ramp intersection may not be as bad as the numbers suggest. Since the operation of the S.R. 87 off-ramp at Santa Clara just south of this one is projected to be above the minimum acceptable standard, it is likely that some of the arena patrons intending to use the more convenient off-ramp would instead opt to use the Santa Clara off-ramp.

11. Stockton and Alameda Intersection

Currently Stockton Street intersects with The Alameda at an acute angle just west of the Southern Pacific/Julian Street underpass. The intersection is controlled by a STOP sign for Stockton traffic. Under existing as well as the 1991 PM peak hour traffic conditions this intersection is and would continue to operate below Level of Service D if it remains unsignalized.

Therefore, it is recommended that this intersection be signalized. If right-of-way permits, Stockton Street should be realigned to improve visibility.

12. Santa Teresa and Santa Clara Intersection

This intersection is exempted from the City of San Jose's level of service policy due to its downtown location. Even so, the following mitigation measures are recommended:

westbound: the segment of roadway between Notre Dame and Santa Teresa be restriped to provide an additional westbound through lane.

eastbound: the segment of roadway between the off-ramp and Terraine be restriped to provide an additional eastbound through lane.

Both of these measures would require parking prohibitions.

Implementation of this mitigation measure would improve the operation of the intersection of Santa Teresa and Santa Clara from LOS F (V/C = 1.471) to LOS F (V/C = 1.073).

Due to physical constraints, no additional mitigation measures are possible at this intersection. When the arena events are held beginning at 6:00 PM, serious operational problems with long queues and delays would occur at this intersection.

13. Autumn and Julian Intersection

It is recommended that the east approach of this intersection be reconstructed to provide an exclusive right-turn lane and the west approach an exclusive left-turn lane. Autumn Street, north of Julian, should have five lanes and should operate with some flexibility in terms of lane arrangements during the time periods when arena events are held.

These improvements may require land acquisitions.

14. Notre Dame and Santa Clara Intersection

It is recommended that the intersection be restriped to provide an additional lane in both the eastbound and westbound directions. This would require parking prohibitions and would improve the operation of this intersection to LOS D (V/C = .893).

15. It is assumed that all the signalized intersections would be operating under optimal signal phasing plans for Year 1991 and Year 2000.

Evening Peak Hours:

1. The mitigation proposed for the intersection of San Pedro with Julian under the PM peak hour conditions would also improve the evening peak hour conditions.

2. Santa Teresa and Santa Clara Intersection and S.R. 87 and Off-Ramp (NB) and Santa Clara

As indicated earlier, it is recommended that the roadway segment between the off-ramp and Santa Teresa be restriped to provide an additional eastbound and westbound through lane. This restriping would require parking prohibitions.

Implementation of this mitigation measure would improve the operation of the intersection of Santa Teresa and Santa Clara to an acceptable level of service.

Late Evening Peak Hour:

It is recommended that the intersection of Montgomery and Julian be under police control for the hour after the conclusion of a major arena event drawing maximum attendance. It is anticipated that the north approach would have heavy turning volumes, requiring the equivalent of two left-turning lanes, and one shared through and right-turning lane.

Year 2000

In addition to the mitigation measures already mentioned, the following improvements are recommended for implementation.

PM Peak Hour

1. S.R. 87 and Taylor Intersection

This intersection has already been discussed under Year 1991. However, it should be noted that for Horizon Year 2000, with or without the arena project, major modifications will be required to improve the intersection operation from its projected LOS F (with V/C = 2.1).

Therefore, the previously recommended improvement that the intersection be grade-separated with ramps constructed to permit all turning movements would be necessary to accommodate the projected Year 2000 base traffic volumes.

2. River Front and Julian Intersection

The following lane geometrics are recommended for this intersection:

north approach: an exclusive left-turn lane, a shared left-turn and through lane and a shared right-turn and through lane.

east approach: an exclusive left-turn lane, three through lanes, and an exclusive right-turn lane.

south approach: an exclusive left-turn lane, an exclusive through lane, and a shared through and right-turn lane.

west approach: an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.

With these lane geometrics, the intersection would operate at an acceptable level of service for Year 2000 PM peak hour conditions with an arena starting time of 6:00 PM. This proposed mitigation would require land acquisition and major reconstruction.

3. River Front and Santa Clara Intersection

With the arena development, there would be increased traffic volumes through this intersection.

It is recommended that this intersection be improved in conjunction with the construction of River Front Road. At the intersection, the north and south approaches should be widened to provide three lanes (including left and right turn lanes). The east and west approaches should have two through lanes plus left and right turn lanes. With these lane geometrics, the intersection would operate under an acceptable level of service.

Transit Service Improvements

In addition to the mitigations discussed in the previous section, improvements in transit service to/from the site would also improve the traffic conditions on the streets and at intersections in the site vicinity. Three ways to improve the transit service to/from the arena site include:

1. Provide additional trains (CalTrain Service) for the peak direction of travel immediately before and after the events.

2. Provide an express bus service between Park & Ride Lot locations and the arena site.

3. Run a shuttle bus service between the LRT stations in the downtown area and the arena site.

4.

PEDESTRIAN ANALYSIS

Site B is planned to have more than 70% of its parking needs provided at parking facilities located away from the arena building for the maximum attendance level. This arrangement will require the arena patrons to walk from remotely located garages to the arena. Consequently, it is necessary to assess the existing facilities available for pedestrians between the parking areas and the arena. Also, in view of the projected pedestrian travel demand of the arena patrons, it is required that the existing pedestrian facilities be improved where necessary to provide safe and convenient pedestrian movement.

This chapter assesses the existing conditions and estimates the future pedestrian facility requirements. Also, the improvements required to serve the arena pedestrian demand to and from Site B are presented here.

4.1 Existing Pedestrian Facilities

There are approximately twelve parking facilities that will serve the arena patrons. These are located east and south of the arena site. Most of the pedestrian traffic would occur between the arena and these facilities. However, some pedestrian traffic is expected to occur west of the arena site along Julian Street.

An inventory of the existing pedestrian facilities was conducted along the perceived pedestrian paths between the parking areas and the arena site. The inventoried facilities included sidewalk widths, pedestrian crosswalks at intersections, traffic regulations, signs, and signal locations with and without pedestrian signal heads. The sidewalk inventory included bus stops, handicap ramps, and the location of sidewalk furniture and other impediments that might restrict pedestrian flow. Also, the intersections with heavy traffic volumes and significant pedestrian crossing conflicts were observed.

The purpose of the inventory was to assess the opportunities and constraints offered by the existing transportation system for pedestrian access and circulation between the major parking areas and the arena. The primary pedestrian paths serving Site B is shown in Figure 25.

4.2 Sidewalk Analysis

The major pedestrian routes leading to the arena are perceived to be along Julian/Saint James Street, San Pedro Street, and Notre Dame Street. The pedestrians from four surface parking lots north of Julian Street would use Bassett Street as their prime route of access to the arena. It should be noted that, at present, there are no sidewalks along Bassett Street.

The sidewalks on the north and south sides of Julian/St. James Street are about 10 feet wide. These narrow to approximately six feet across the bridge over the Guadalupe

Barton-Aschman Associates, Inc.

Figure-25
SITE "B" PRIMARY PEDESTRIAN PATHS

River. Sidewalk widths along San Pedro Street, Notre Dame Street, and North Almaden vary between 6 and 14 feet.

It is anticipated that the pedestrians from the parking facilities along San Pedro Street, Notre Dame Street, and North Almaden Boulevard would use the respective north-south street to reach Julian Street and then use Julian Street to reach the arena. The north-south streets would not have heavy pedestrian flows because only one of the parking garages is located on each different street. These north-south streets offer sufficient sidewalk capacity for the demand generated by these individual garages. However, Julian Street would have heavy pedestrian traffic. This street would collect the flows from the north-south streets and would provide access to the arena site through the Julian Street crossing under Route 87.

It should be noted that the pedestrian flow would be in the form of platoons. Platoon flow is defined as the grouping or bunching of pedestrians because of internal or external impedances. These groups will be characterized by increasing behavioral consistencies manifested in the adoption of a prevalent group speed and positioning arrangement.

Recent research[5] has indicated that the level of service occurring in platoons is generally about one level of service lower than the level indicated based on average flow criteria. In platoon flow it would seem likely that behavioral norm will evolve whereby pedestrians may be willing to accept smaller buffer zones at disproportionately higher speeds than indicated by the level of service criteria for average conditions.

Based on the recent research it is estimated that for Level of Service D a pedestrian flow of about 30 pedestrians per minute per foot width of the sidewalk can be accommodated. Assuming that the 10 foot sidewalk will only have an 8 foot effective width, each side would accommodate 240 pedestrian per minute or 480 on both sides of the street.

According to the surveys conducted for the arrival patterns for special events such as basketball and other entertainment, the pattern arrive at different rates per ten-minute period. The largest percentage reported to arrive for entertainment events within a ten minute period was 24% occurring 20 to 30 minutes before the start of the event.

For a 20,000 capacity crowd, it was estimated that the largest average flow of pedestrians to the site would be 500 pedestrians per minute. However, there are three different ways to approach the arena site on foot. These are Bassett Street, Julian Street, and North Almaden extension under Route 87. It is estimated that about 16% of the pedestrians would use Bassett Street and about 13% would use the Almaden extension. Therefore, the remaining 70% would approach the arena from the east side on Julian Street. Out of 500 per minute arrivals, 70%, or 350, will be using Julian Street. This demand of 350 pedestrians when compared with the available capacity of 480 pedestrians on Julian Street, would produce a Level of Service D.

5 Level-of-Service standards for Platooning Pedestrian in Transportation Terminals by Dennis G. Davis and John P. Braaksina.

The proposed extension of North Almaden under Route 87 should be designed with sidewalks to provide a pedestrian connection from east of Route 87 to the arena on the west side. It is also recommended that the proposed plaza in front of the arena building on the north side of Julian Street be connected with the sidewalk on Julian Street to provide direct access between the sidewalk and the plaza. The existing Old Julian Street bridge should be converted into a pedestrian bridge to provide access to the arena from the west side. Also, the Bassett Street section between San Pedro Street and the arena should provide ten-foot wide sidewalks.

4.3 Pedestrian Crosswalk Analysis

Almost all of the intersections along the perceived paths of the pedestrians between the parking areas and the arena have striped pedestrian crosswalks at the intersections to provide safe and convenient street crossings. The section of Julian Street in the vicinity of Route 87 is currently under construction. Once this construction is completed, pedestrian crosswalks will be striped at the new intersections.

A detailed inventory was conducted to obtain information regarding the existing traffic signal locations, pedestrian signal head locations, pedestrian crosswalks, and availability of handicap ramps at the critical intersections along the perceived pedestrian paths of arena patrons. This information was used to determine the adequacy of pedestrian movements along Julian/Saint James Street. The following paragraphs present brief descriptions of the available opportunities and constraints on the pedestrian routes along Julian/Saint James Street.

Traffic Signals:

The existing traffic signals along Julian Street between Market Street and North Almaden Boulevard will require new signal phasing and timing plans to accommodate future automobile and pedestrian traffic generated by the arena patrons. A signal timing analysis conducted for the signalized intersections showed that a 90-second cycle will be necessary. Due to heavy pedestrian crossing demand, the timing plans would require a longer pedestrian time for the east-west movement. As most of the automobile traffic would also be in the east-west direction, this movement could be favored as opposed to the north-south direction. Also, a new traffic signal with pedestrian heads would be required at the Julian Street and Autumn Street intersection. If the existing signal controllers are not capable of utilizing different signal timing plans at different times of the day, a new master controller will be required. These signals will require interconnection to provide signal synchronization.

Pedestrian Signal Heads:

The existing signals along Julian Street between Market Street and Notre Dame are equiped with pedestrian signal heads. The new controllers at Route 87 and Julian Street interchange ramp intersections will require pedestrian heads.

Crosswalks:

All of the intersections along Julian Street between Market Street and the arena site have crosswalks. The new intersections of Route 87 ramps with Julian Street will have crosswalks after construction is completed.

Handicap Ramps:

All of the existing intersections along Julian Street between Market and Notre Dame have ramps to serve handicapped persons.

4.4 Street Lighting

Currently street lighting exists on all streets expected to be used by pedestrians walking between the arena and the parking facilities. However, there are certain areas where higher levels of illumination would be required. Specifically, the section of Julian Street between Market Street and Stockton Street would require higher levels of illumination than what is currently provided. The plaza area in front of the arena and the east and west side of the arena building should be well illuminated with flood lights in order to provide a safe environment for pedestrians.

5. NEIGHBORHOOD IMPACTS

Two types of neighborhood impacts are anticipated if the arena is located on Site B. The first impact is the use of neighborhood streets for parking by arena patrons. The second impact is the infiltration of arena traffic on the surrounding neighborhood streets. Both of these impacts are discussed below. Also, possible solutions to eliminate or minimize these impacts are presented.

5.1 Neighborhood Parking Impacts

When an activity center, such as an arena, is introduced within a reasonable walking distance of a residential neighborhood, a certain number of persons will always attempt to park their cars in the neighborhoods to avoid parking costs or traffic congestion. This will occur regardless of how much parking is provided at the activity center.

Strong measures are required to ensure that neighborhood streets do not turned into a parking facility when arena events are taking place.

On-Street Neighborhood Parking

The neighborhood on-street parking inventory and usage survey, discussed in Section 2.1, were conducted to understand the existing parking supply and demand situation. It was not conducted to condone the use of neighborhood streets for parking by arena patrons. The results of the existing parking survey indicate there are available parking spaces in the neighborhoods surrounding Site B. Therefore, arena patrons would attempt to park on the neighborhood streets since these free spaces are conveniently located.

One of the more effective ways to solve the problem of arena patrons parking on neighborhood streets would be to plan, design, and implement a residential permit parking policy for selected areas in the vicinity of the arena site. This plan can be implemented if the neighborhood residents request such a program.

Permit parking is relatively simple to implement and enforce. Residents would be issued parking permits for each registered vehicle plus a visitor parking permit for their private use. The streets would be signed to allow parking only for vehicles displaying permits. Vehicles without permits would be issued a parking ticket and a fine would be imposed for each violation. Very strict enforcement is a key element in making this program a success.

It is strongly recommended that if this site is selected, a residential permit parking plan should be implemented if the residents request such a measure.

Off-Street Neighborhood Parking

In the vicinity of Site B, there exists a few private surface parking lots off of The Alameda west of Stockton Avenue. These lots could potentially provide parking for an estimated 200 automobiles. Although this parking supply was not assumed in this study, the lots were considered in the analysis of potential neighborhood impacts by an arena development on Site B. This potential parking supply could generate up to an estimated 200 trips through the streets serving these lots during the arena peak hour(s) of traffic activity.

This problem of neighborhood parking and the resulting traffic impact can be resolved in two ways. The first method would be to restrict such off-street parking in the residential neighborhoods. The second way is to erect barricades during arena events to eliminate arena traffic from neighborhood streets.

5.2 Neighborhood Traffic Impacts

The automobile traffic to and from the arena is expected to primarily use the major street system. However, some arena patrons would infiltrate the neighborhood streets to circumvent congestion on the major streets or to park on the neighborhood streets or in a neighborhood parking lot. This added traffic will cause inconvenience and annoyance to the residents.

To alleviate the neighborhood street impacts from the proposed arena site, it is recommended that a commitment be made towards planning, designing, and implementing a neighborhood traffic control program. This program should be implemented only after the arena is in operation and the neighborhoods have been closely monitored to ascertain the amount of infringement of arena traffic on the local residential streets in the vicinity of the arena site. A similar study is being undertaken by the Traffic Operations Department of the City of San Jose at the request of Shasta/Hanchett Park Neighborhood Association. A number of recommendations are being prepared for discussions with the neighborhood group. It is anticipated that these recommendations would be implemented prior to the opening of the arena at Site B.

This neighborhood traffic control program, once implemented, is expected to minimize the cut-through commuter traffic. After the opening of the arena, if it is determined that the arena patrons are utilizing the residential streets, it would be necessary to erect temporary barricades to eliminate this problem during arena operation.

5.3 Conclusions

The construction of a facility such as the arena creates traffic and parking concerns for the residents in the surrounding neighborhood.

A full commitment should be made to the neighborhood residents to thoroughly investigate any impacts occurring after the opening of the arena and to implement solutions acceptable to them.

6. CONCLUSIONS

A summary of the recommendations presented in Chapters 2 through 5 are presented below. The basis for these recommendations are a number of conditions and assumptions which were discussed in each of the chapters. If these conditions are satisfied, then the following conclusions are valid.

6.1 Parking

Summary of Analysis

The available parking supply analysis indicated that there would be 6,490 parking spaces available for arena patrons for evening and weekend performances. The parking demand analysis showed that there would be a need for 5,660 spaces for a 17,500 seat arena and 6,470 spaces for a 20,000 seat facility. Therefore, there would be an excess of about 830 available parking spaces to serve arena patrons for the 17,500 seat arena and 20 spaces for the 20,000 seat arena in the general area. This surplus would ensure sufficient parking supply for arena patrons for evening and weekend events.

The weekday afternoon shows would require an estimated 2,610 spaces. All but 270 spaces could be reserved for these events. The several private parking facilities could satisfy the remaining demand of 65 spaces.

It is worth pointing out that the surface parking lots located east of Route 87 may be replaced by other developments in the future. However, in all probability the new developments would each provide its own parking shich would still be available for arena patrons during evenings and weekends.

Proposed Parking Strategies

The parking demand and supply analysis outlined in Chapter 2 led to the following parking strategy.

1. Site B would provide 2,020 parking spaces on site. These spaces should be reserved for arena patrons only.
2. A comprehensive long term plan should be prepared to provide parking for arena employees at a location away from the site. This arrangement should be strictly enforced.
3. Arrangements should be made to provide parking areas for truck-trailers and rigs used for the arena events, away from the site during the arena performance. This arrangement should be strictly enforced.

4. Arrangements should be made to provide on-site parking for charter buses used by arena patrons.

5. In order to ensure the availability of privately owned parking facilities for arena patrons, arrangements should be made with the owners of these facilities.

6. The parking demand for afternoon matinee events should be monitored closely. If the demand exceeds the supply, arrangements should be made to increase the parking at or near the arena.

6.2 Traffic

The following improvements would be required to mitigate the traffic impact generated by an arena facility located on Site A for Year 1991 and Year 2000.

<u>For Year 1991</u>

PM Peak Hour:

1. Alameda and Taylor/Naglee Intersection

   It is recommended that the intersection be restriped and reconstructed to provide an additional lane in both directions. This would require parking prohibitions on both sides of Alameda.

2. Coleman and Taylor Intersection

   Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection.

3. S.R. 87 and Taylor Intersection

   It is recommended that this intersection be grade-separated with ramps constructed to permit all turning movements.

4. S.R. 87 Off-Ramp (SB) and Coleman Intersection

   It is recommended that an additional through lane be added in both the eastbound and westbound directions, if feasible. This would improve the intersection operation to acceptable standards.

5. San Pedro and Julian Intersection

   Due to its downtown location , this intersection is exempted from the City of San Jose's Level of Service Policy. Even so, it is recommended that a signal be installed at this intersection. Implementation of this mitigation measure would not only improve the operation of this intersection during the PM peak hour, but during the evening peak hours as well. Also, San Pedro should be realigned to improve visibility.

6. Market and Julian Intersection

   Under existing conditions, this intersection is constructed up to its right-of-way limits. No mitigations are proposed for this intersection.

7. The Alameda and Julian/Hanchett Intersection

   To improve the operation of this intersection during this time period, it is recommended that a barrier median be constructed on Alameda across its intersection with Hanchett. This barrier median extension will result in additional storage capacity for left-turning vehicles. Implementation of this mitigation measure will restrict the movements on Hanchett Avenue to include only right-turns in and out of this intersection. In addition, it is recommended that an island be constructed on the Hanchett leg. This will assist drivers and provide them with a clear indicator of the permitted movements.

8. Stockton and Julian Intersection

   In order to improve the operation of this intersection during this time period, it would be necessary to reconstruct this intersection to provide the following lane geometrics:

   north approach: an exclusive right-turn lane, an exclusive through lane, a shared through and left-turn lane, and an exclusive left-turn lane.

   west approach: a shared through and right-turn lane and a shared through and left-turn lane.

   Implementation of these mitigation measures would require land acquisition and the widening of the Julian underpass to provide a four-lane cross-section.

9. S.R. 87 On-Ramp (SB) and Julian Intersection

   This intersection is exempted from the City of San Jose's Level of Service Policy due to its downtown location. Even so, it is recommended that the north approach (i.e. southbound off-ramp) be widened to provide an additional shared through and left-turn lane.

10. S.R. 87 On-Ramp (NB)/Notre Dame and Julian Intersection

    This intersection is exempted from the City of San Jose's Level of Service Policy. With the arena traffic included, this intersection is projected to operate at LOS F (V/C = 1.128). For the two or three times during the year when events start at 6:00 PM the operation of this intersection would remain below acceptable standards. The maximum back of queue estimated for the off-ramp traffic extends 250 feet south of the nose of the off-ramp.

11. Stockton and Alameda Intersection

    It is recommended that this intersection be signalized. If right-of-way permits, Stockton Street should be realigned to improve visibility.

12. Santa Teresa and Santa Clara Intersection

This intersection is exempted from the City of San Jose's level of service policy due to its downtown location. Even so, the following mitigation measures are recommended:

westbound: the segment of roadway between Notre Dame and Santa Teresa be restriped to provide an additional westbound through lane.

eastbound: the segment of roadway between the off-ramp and Terraine be restriped to provide an additional eastbound through lane.

Both of these measures would require parking prohibitions.

Implementation of this mitigation measure would improve the operation of the intersection of Santa Teresa and Santa Clara from LOS F (V/C = 1.471) to LOS F (V/C = 1.073).

Due to physical constraints, no additional mitigation measures are possible at this intersection. When the arena events are held beginning at 6:00 PM, serious operational problems with long queues and delays would occur at this intersection.

13. Autumn and Julian Intersection

It is recommended that the east approach of this intersection be reconstructed to provide an exclusive right-turn lane and the west approach an exclusive left-turn lane. Autumn Street, north of Julian, should have five lanes and should operate with some flexibility in terms of lane arrangements during the time periods when arena events are held.

These improvements may require land acquisitions.

14. Notre Dame and Santa Clara Intersection

It is recommended that the intersection be restriped to provide an additional lane in both the eastbound and westbound directions. This would require parking prohibitions.

15. It is recommended that the intersection of Montgomery and Julian be under police control for the hour after the conclusion of a major arena event drawing maximum attendance. It is anticipated that the north approach would have heavy turning volumes, requiring the equivalent of two left-turning lanes, and one shared through and right-turning lane.

16. It is assumed that all the signalized intersections would be operating under optimal signal phasing plans for Year 1991 and Year 2000.

For Year 2000

In addition to the mitigation measures already mentioned the following improvements are recommended for implementation.

1. S.R. 87 and Taylor Intersection

This intersection has already been discussed under Year 1991. However, it should be noted that for Horizon Year 2000, with or without the arena project, major modifications will be required to improve the intersection operation from its projected LOS F (with V/C = 2.1). Therefore, the previously recommended improvement that the intersection be grade-separated with ramps constructed to permit all turning movements would be necessary to accommodate the projected Year 2000 base traffic volumes.

2. River Front and Julian Intersection

The following lane geometrics are recommended for this intersection:

north approach: an exclusive left-turn lane, a shared left-turn and through lane and a shared right-turn and through lane.

east approach: an exclusive left-turn lane, three through lanes, and an exclusive right-turn lane.

south approach: an exclusive left-turn lane, an exclusive through lane, and a shared through and right-turn lane.

west approach: an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.

With these lane geometrics, the intersection would operate at an acceptable level of service for Year 2000 PM peak hour conditions with an arena starting time of 6:00 PM. This proposed mitigation would require land acquisition and major reconstruction.

3. River Front and Santa Clara Intersection

It is recommended that this intersection be improved in conjunction with the construction of River Front Road. At the intersection the north and south approaches should be widened to provide three lanes (including left and right turn lanes). The east and west approaches should have two through lanes plus left and right turn lanes. With these lane geometrics, the intersection would operate under an acceptable level of service.

Transit Service Improvements

In addition to the mitigations discussed in the previous section, improvements in transit service to/from the site would also improve the traffic conditions on the streets and at intersections in the site vicinity. Three ways to improve the transit service to/from the arena site include:

1. Provide additional trains (CalTrain Service) for the peak direction of travel immediately before and after the events.

2. Provide an express bus service between Park & Ride Lot locations and the arena site.

3. Run a shuttle bus service between the LRT stations in the downtown area and the arena site.

6.3 Pedestrian

1. The proposed extension of North Almaden under Route 87 should be designed with sidewalks to provide a pedestrian connection from east of Route 87 to the arena on the west side.

2. It is also recommended that the proposed plaza in front of the arena building on the north side of Julian Street be connected with the sidewalk on Julian Street to provide direct access between the sidewalk and the plaza.

3. The existing Old Julian Street bridge should be converted into a pedestrian bridge to provide access to the arena from the west side.

4. The Bassett Street section between San Pedro Street and the arena should provide ten-foot wide sidewalks.

5. The existing traffic signals along Julian Street between Market Street and North Almaden Boulevard will require new signal phasing and timing plans for accommodating future automobile and pedestrian traffic.

6. Street lighting should be improved for the section of Julian Street between Market Street and Stockton Street. The plaza area in front of the arena and the east and west sides of the building should also be well illuminated with floodlights to provide a safe environment for pedestrians.

6.4 Neighborhood Impacts

1. It is recommended that if the residents request a residential permit parking plan, then it should be implemented and strictly enforced to control on-street neighborhood parking.

2. It is also recommended that a neighborhood traffic control program be developed. As part of this program, the residential streets would be monitored after the opening of the arena. If at that time, the arena patrons are found to be utilizing residential streets, measures such as the placement of temporary barricades should be considered during arena operation.

APPENDIX B-2

AIR QUALITY ANALYSIS

ENVIRONMENTAL CONSULTING SERVICES

CUPERTINO, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

Environmental Consulting Services

Noise
Air Quality
Energy

20430H Town Center Lane
Cupertino, CA 95014
(408) 257-1045

AIR QUALITY IMPACT AND MITIGATION STUDY

SAN JOSE SPORTS ARENA PROJECT - SITE B

San Jose, CA

July 17, 1987

Submitted to

DAVID J. POWERS & ASSOCIATES

San Jose, CA

Prepared by

H. STANTON SHELLY

Principal Consultant

AIR QUALITY SECTION

INTRODUCTION

The air quality of a given area is not only dependent upon the amount of air pollutants emitted locally or within the air basin, but also is directly related to the weather patterns of the region. The wind speed and direction, the temperature profile of the atmosphere, and the amount of humidity and sunlight determine the fate of the emitted pollutants each day, and determine the resulting concentrations of air pollutants defining the "air quality."

I. EXISTING SETTING

A. Regional Climate.

The Bay Area climate is a Mediterranean type, characterized by mild and rainy winters, and warm and nearly dry summers. There is a high percentage of sunshine, especially in the summer after the typical morning fog burns off. The temperature, humidity, wind, and precipitation throughout the year depend entirely upon the the movements of marine air, the location and strength of the dominant Pacific high-pressure system, and the coastal temperature gradient.

During the summer the Pacific high typically sits near the California coast, pushing oncoming eastbound storm systems north through the northwest states and Canada. Subsidence of warm air aloft associated with this system creates the frequent summer atmospheric temperature inversion and stagnated conditions. (See the Appendix for definitions of commonly-used meteorological and air quality terms.) The persistent reversal of the normal atmospheric temperature lapse rate (change with temperature) may be several hundred to several thousand feet thick, effectively trapping pollutants emitted at ground level. Winds during the summer are generally light, except for late afternoon onshore flow from differential heating

between the cool ocean and the warm land mass. Average temperatures increase as distance from the Golden Gate increases. Average maximum temperatures during tle summer are near 80° F. in the South Bay, and average evening minimums are near 50° F.

During the winter the Pacific high pressure system moves southward, allowing ocean-formed storms to move through the region. With the dominance of the unstable low-pressure systems during the winter, and less sunshine, conditions favoring smog formation are at a minimum. However, radiation cooling during the evening hours sometimes creates thin inversions, concentrating carbon monoxide emissions at ground level. Average maximum winter temperatures in Santa Clara County are about 60° F., and average evening lows are about 40° F.

Lying in the rain shadow of the Santa Cruz Mountains, the South Bay receives only 2/3 of the precipitation which falls upon San Francisco, and a quarter of that falling in the coastal mountains. Very little rain falls in May and October, usually near half an inch, and almost none from June through September. A majority of the rainfall comes in December, January and February, about 3.5 inches per month in normal rainfall years. The annual average rainfall in the South Bay is in the 13 - 15 inch range.

B. Wind Charactistics in the South Bay

Wind in the South Bay is predominantly from the northwest, approximately 30% of the time during the winter, and over 50% during the summer months, as shown in the summary of wind data for downtown San Jose presented in Exhibit 1. The northwest winds are a result of ocean-driven flow coming through the Golden Gate and toward the south bay. During mid-winter months southeasterly winds are present nearly 40% of the time due to freqent low-pressure storm fronts, and their characteristic counter-clockwise flow. Calm conditions occur nearly 13% of the time during the winter, but only 5% during the summer.

EXHIBIT 1 - San Jose Wind Setting

Direction	% of Time	Mean Speed (mph)
Annual Distribution		
NE	3.1	1.5
E	0.5	1.4
SE	16.9	2.7
S	19.2	4.2
SW	6.8	2.2
W	1.1	2.5
NW	40.7	4.3
N	2.9	2.4
Calm	8.9	---
	100	3.3
Winter Distribution		
NE	2.9	1.5
E	0.5	1.4
SE	20.8	2.6
S	23.5	4.4
SW	7.9	1.9
W	1.5	2.4
NW	28.1	3.9
N	2.1	2.6
Calm	12.7	---
	100	3.0
Summer Distribution		
NE	3.0	1.5
E	0.4	1.5
SE	11.4	3.0
S	17.4	4.3
SW	5.4	2.6
W	0.6	2.9
NW	52.8	4.6
N	3.9	2.4
Calm	5.1	---
	100	3.8

Average wind speeds in the downtown San Jose project area are less than 5 mph on an annual average basis. The highest wind speeds occur during late afternoon on-shore cooling in the summer, and during winter storms. During storm periods winds frequently gust at 20 to 30 mph.

C. Ambient Air Quality

Air quality near the project area in downton San Jose is subject to the problems experienced by most of the Bay Area, and particularly the south portion. Emissions from millions of vehicle-miles of travel each day often are not mixed and diluted, but are trapped near ground level by a temperature inversion. Prevailing air currents generally sweep from the mouth of the Bay toward the south, picking up and concentrating pollutants in the basin around San Jose and the Almaden Valley. A combination of emissions in the South Bay, the transport of pollutants from other areas, and the natural mountain barriers (the Diablo Range to the east and the Santa Cruz Range to the southwest) produce high concentrations, which sometimes exceed ambient air quality limits established by the Bay Area Air Quality Management District (BAAQMD). The most recent air quality data from the nearest BAAQMD monitoring station on 4th Street in San Jose, and the ambient standards presently in effect, are tabulated in Exhibit 2.

Ozone, the primary oxidant "smog" component, is produced by complex reactions of hydrocarbons and NO_x in the atmosphere. Daily ozone concentrations are heavily dependent upon the weather, and thus vary substantially from year to year. Since the adverse atmospheric conditions in 1978, when 12 exceedances were recorded in San Jose, high oxidant days had been significantly lower. However, 1983 and 1984 were unusually warm and stratified ozone seasons, with 9 and 7 exceedances, respectively. The 1985 and 1986 summer weather was cooler and had a more normal ventilation pattern, bringing ozone exceedances back down. The 3-year Expected Annual Exceedance value (average of last three years) is now 3.3.

EXHIBIT 2

AMBIENT AIR QUALITY

Downtown San Jose

POLLUTANT	1984	1985	1986	Std	Meas. Units
OZONE					
Maximum	16	14	14	12 (1)	pphm, 1-hr ave
Exceedances	7	2	1	1	days per year
3-year average	5.3	6.0	3.3	1	Expected Annual Exceedances
CARBON MONOXIDE					
Maximum 8-hour	20	21	11	9 (2)	ppm, 8-hr ave
8-hour exceedances	5	17	4	1	days per year
NITROGEN DIOXIDE					
Maximum	18	19	16	25 (3)	pphm 1-hr ave
Exceedances	0	0	0	1	days per year
TOTAL SUSPENDED PARTICULATES					
Annual mean	79	90	(6)	60 (4)	annual geometric mean
Daily exceedances	6	19	24	1 (5)	% of days above 150 ug/m^3

NOTES:

(1) Federal standard; State standard is 10 pphm.
(2) Federal and State ambient standard; State standard is also 20 pphm for 1 hour.
(3) State standard; Federal standard is 5 pphm annual average.
(4) State standard; Federal standard is 75 ug/m^3
(5) Federal standard; State standard is 100 ug/m^3, measured as thoracic particles (small diameter).
(6) Not published for 1986

Source: BAAQMD monitoring data -- 4th Street station, S.J.

Another problem pollutant in the South Bay, carbon monoxide, like oxidant, is also heavily dependent upon both vehicle emissions and weather. High CO concentrations in the South Bay occur mostly during winter evenings with little wind. Exceedances of the 9 ppm 8-hour ambient standard increased to 17 during 1985 in San Jose, the highest number of exceedances since 1979, but dropped again in 1986, to 4 incidents. Both CO and oxidant have been reduced significantly by improved emission controls on new automobiles in the past decade.

Total suspended particulates, produced by vehicles, heavy industry, and soil-moving activities, dropped impressively in 1983, but heavy construction in downtown San Jose have produced high concentrations since 1984. The ambient standard of 100 ug/m^3 for 24-hour sampling has been exceeded a significant number of the days tested in downtown San Jose for the past three years. These readings are not considered representative of the general San Jose exposure, but they are probably fairly representative of the nearby project area.

Sulfur dioxide is primarily associated with chemical and refining industries, and has never approached the ambient standard in the San Jose area, nor have SO_2 standards been exceeded anywhere in the District since 1976, and are not reported now in the South Bay.

Nitrogen oxides are produced heavily by vehicles and high-temperature industrial operations, but as yet have not posed serious problems in the region. The South Bay often has the highest NO_x concentrations in the District, however.

Because there are exceedances of some ambient standards in the Bay Area, the District has been designated a Non-Attainment Area by the Environmental Protection Agency for CO, ozone, and TSP. All significant sources in the District must share responsibility for basin exceedances, including those sources in locations where air quality is good.

II. POTENTIAL AIR QUALITY IMPACTS OF PROJECT

The scope of the San Jose Sports Arena project is the siting and construction of a new City Sports Arena in one of three locations in the San Jose metropolitan area. This study evaluates potential air quality impacts associated with the "Site B" alternative adjacent to Guadelupe Expressway at W. Julian. The project includes a small surface parking lot adjacent and an additional 4-level parking garage for approximately 1320 vehicles.

Vehicle trips carrying patrons to and from events at the Sports Arena are the primary sources of emissions associated with the implementation of the project. The trip profile associated with the Sports Arena is an incoming group of vehicles (approximately one vehicle per 3 patrons) in the 90 minutes or so prior to event starting time, and the reverse trip pattern in the 60 minutes following the event. This profile is essentially superimposed upon the existing commute-based traffic pattern. The peak arrival traffic for a normal weekday evening event is expected to follow the afternoon peak commute period closely, but not coincide with it.

Other types of air quality impacts associated with this project, such as stationary sources of pollutants, include heating system emissions, which represent a minimal contribution. Potential dust and particulates generated during site preparation and grading may be controlled by routine application of water and/or road oil.

Particulates generated by roadway resuspension are relatively small amounts very near the roadway. Although it is possible to estimate a range of values for these contributions, the estimates would have little validity except under specific and controlled conditions not found in actual practice.

A. Sensitive Receptor Locations

Sensitive receptors for potential air quality impacts of the San Jose Sports Arena project are primarily the older residential neighborhoods to the northeast of Julian/Guadelupe and southwest of Stockton Avenue. A few scattered residential locations in the areas west of the site also remain.

Representative worst-case receptor locations have been selected at (1) Fox Avenue and San Pedro, another at (2) Rhodes and W. Julian, and (3) at Montgomery and W. Julian (refer to the Project Map, Appendix Page A-3). The extent to which these locations would be affected by the proposed project is evaluated in the following sections. Other receptor locations in the project area would experience similar or lesser impacts.

B. Data and Methodology

Vehicles are responsible for emission of a number of pollutants -- carbon monoxide (CO), hydrocarbons, particulates, NOx, and others. The most widely-used method of evaluating the potential impact of project vehicular emissions is modeling the concentration of CO at nearby sensitive receptor locations.

Vehicular carbon monoxide emissions are directly related to the number of vehicle trips, and to the average vehicle emission rate. Newer vehicles have lower emission rates than older vehicles because of better emission controls. In addition, average emissions per mile decrease as average speed increases. But after the pollutants are emitted, atmospheric conditions control pollutant mixing, dispersion, and the ultimate concentrations achieved. These interrelated factors are considered in a simplified way by roadside CO dispersion modeling.

The CALINE 3 multiple line-source model used for this study was developed by the California Department of Transportation (Ref. 5), based upon standard Gaussian diffusion relationships developed by Turner (Ref. 6) and others. In basic terms, CALINE takes emissions from major arterials in the area, under stagnated atmospheric conditions and low wind speed, and sums the contributions of major roadways at selected receptors for various wind directions.

To evaluate the potential air quality impacts, six traffic conditions are evaluated and compared, based upon the traffic study for the project by Barton-Aschman Associates, Inc, San Jose (July 1987):

1. Existing 1987 traffic
2. Base case 1991 traffic
3. Year 1991 traffic, 17,500-patron event
4. Year 1991 traffic, 20,000-patron event
5. Year 2000 traffic, 17,500-patron event
6. Year 2000 traffic, 20,000-patron event

A list of specific streets included in the analysis is given in Exhibit 3.

CALINE modeling parameters, and input geometric and traffic parameters used are described on Appendix Page A-4. Sample modeling summary sheets for three traffic conditions are on the following pages in the Appendix, which give parameter values as well as the resulting CO concentrations in parts per million (ppm) for each receptor. Composite vehicle emission factors are taken from the California Air Resources Board EMFAC 6 program (Ref. 7).

Exhibit 3
Streets Modeled with CALINE

Coleman Avenue	Market Street
Guadelupe Expressway	Julian Street
W. Santa Clara Street	The Alameda
Montgomery Street	Autumn Street
Stockton Avenue	Naglee Street

Note: Some streets are modeled in 2 or 3 segments

C. Impact Analyses

Carbon monoxide concentrations at the three receptors have been modeled during peak hour for each traffic condition and for eight wind conditions. Emissions are accumulated by CALINE from each of 20 street segments ("links")

in the project area defined by the streets listed in Exhibit 3. CO concentrations for the wind directions giving the highest values are tabulated in Exhibit 4 below for the six cases.

Exhibit 4
PEAK HOUR CARBON MONOXIDE MODELING (ppm)

CASE	RECEPTOR 1	2	3
1. Existing - 1987	1.3	0.4	0.8
2. Base case - 1991	0.6	0.5	1.1
3. Year 1991 - 17,500	0.6	0.5	1.2
4. Year 1991 - 20,000	0.6	0.5	1.2
5. Year 2000 - 17,500	0.5	0.7	0.8
6. Year 2000 - 20,000	0.5	0.7	0.8

Local Background Concentration : 12 ppm
Ambient Standard : 20 ppm

Exhibit 4 shows that traffic associated with the Sports Arena will not increase air quality concentrations at residential receptors in the vicinity in any significant way. This is because project traffic volumes will be distributed on a number of access streets in the area, while average emissions per vehicle continue to be reduced, as newer vehicles with superior emission controls replace older vehicles. In addition, the completion of the Guadelupe Freeway connection in the area is expected to divert some local street traffic and relieve associated congestion, which will reduce emissions and CO concentrations near local arterials, particularly near Receptor 1.

Background concentrations are the combined result of vehicular emissions from all streets in an area; the values listed are taken from Pages V-10 and V-11 of the BAAQMD Assessment Guidelines (Ref. 8). The total CO concentrations under stagnated atmospheric conditions are the sum of local background plus the modeled concentrations, which would not appear to cause the State ambient standards to be exceeded, with or without the project.

However, some simplifications are made by the modeling procedure, one of which is to assume a constant lower-speed traffic flow during peak hour conditions, rather than stop-and-go cycles. At some congested intersections, emissions could be higher than modeled. In addition, under severe atmospheric stagnation which occurs a few times each year (near-zero wind speeds and a very low atmospheric inversion, which cannot be modeled in a straightforward fashion), ambient standards could be exceeded. To the extent that Sports Arena events coincide with these stagnation periods, the project would contribute to increased local CO concentrations at a time when ambient standards are exceeded throughout the south bay region.

D. Total Project Emissions

Another way of assessing potential air quality impacts is to estimate the total daily project-related vehicular emissions. The Sports Arena will not have a consistant "daily" contribution, but an event could occur a few times per week. Total emissions are computed by considering the emissions associated with the 6,500 project trips with an average trip length of 20 miles (per Ref. 8, Table VI-B-1). Exhibit 5 is a comparison of total emissions for the four pollutants of concern.

Exhibit 5
Emissions Comparisons (1995 - Tons per day)

	CO	NMHC	NOx	PART
Project	0.18	.015	.019	.004
BAAQM District				
Vehicle	1430	142	183	351
Total	2160	532	486	708
Santa Clara County				
Vehicle	24%	12%	14%	12%
Total	26%	24%	18%	23%

Emissions are converted to tons per day to relate them to the estimated total District vehicular emissions in the year 1995. Santa Clara County emissions, as a percent of District emissions, also are tabulated for comparison. All non-project emission estimates are from Reference 9.

E. Relationship Of Project To District Air Quality Plan (AQP)

The 1982 Bay Area Air Quality Plan (Ref. 9) presents the policies and methods adopted for meeting the mandated National Ambient Air Quality Standards in the Bay Area. The recommended policies in the AQP which would be most relevent to reviewing agencies and individual projects are designated "Transportation Control Measures (TCMs)," acknowledging the primary role vehicles play in air quality control problems and their solution.

F. Parking-Related Air Quality Impacts

In addition to the emissions generated by the Sports Arena patrons driving to and from the site, short-term emissions incidents would be produced while the vehicles are entering and leaving a parking lot or garage, particularly while leaving. After an event patrons leave essentially at the same time, with many vehicles idling while in queue to exit a parking lot or garage. This section discusses concentrations adjacent to a Sports Arena parking lot and inside a parking garage following an event.

<u>Parking Lot Idling Emissions</u>

The receptor CO concentrations downwind from an area source such as a parking lot are given in the following relationship from Reference 10:

$$C = \frac{0.8\,Q\,(x2^{(1-b)} - x1^{(1-b)})}{A\,U\,a\,(1-b)\,R}$$

where

x1 = the distance to the near boundary of lot (meters)
x2 = the distance to the far boundary of lot (meters)
A = area of parking lot ($meters^2$)
U = wind speed (meters/sec)
a,b = atmospheric dispersion parameters
Q = emission rate of lot (mg/sec)
R = conversion factor from mg/m^3 to ppm
C = concentration of CO (ppm)

Using this model to estimate concentrations near (100 feet) the proposed 200-car parking lot, assuming poor atmospheric conditions, 1 meter per second wind speed, a full lot of vehicles idling at once, the receptor concentration of CO would be 6.4 ppm.

<u>CO Concentrations Inside a Parking Garage</u>

Idling motor vehicles within enclosed areas produce the most serious human exposures to carbon monoxide. Examples include heavily-traveled tunnels and relatively closed parking garages. Even so, if traffic is evenly distributed, so that only a few autos are operating at the same time, high concentrations do not build up. Parking garages dedicated to scheduled events such as the proposed Sports Arena, as opposed to more evenly distributed retail or commercial use, are the most severe parking garage exposures.

For the proposed 4-level, 1320-vehicle parking garage in the Site B alternative, the following assumptions have been used:

Size of interior garage level : 300' x 300' x 10'
Vehicles per level : 330
Vehicle time spent idling in garage : 15 minutes
Air flow : 10 meters per minute

The modeling relationship, adapted from Reference 10, is as follows :

$$C = \frac{Qa \times T}{H \times R}$$

where the parameters different than in the previous parking lot computation are :

Qa = emission rate ($mg/min*m^2$)
T = time for wind to cross garage = D/U (min)
D = distance across garage (m)
H = interior height of garage level (m)

For the assumptions and parameters above, interior locations at the "downwind" side of the garage would experience a CO concentration of 240 ppm, while the upwind side of the garage would experience basically ambient concentrations. For faster air flow through the garage, fewer vehicles operating at once, or shorter periods of idling (vehicles leaving garage more quickly), the CO concentration would be proportionately lower.

The recommended maximum one hour exposure to CO is 20 ppm, to prevent elevated carbon monoxide levels in the blood, which can cause temporary deficiencies in the ability to do physical and mental tasks, and may cause headaches. Although this type of exposure is not unique to the parking garage for this project, and cigarette smokers typically inhale 400-500 ppm concentrations of CO, the exposure should not be taken lightly even for infrequent exposures.

Open-architecture garage design promoting both natural convection and wind-driven ventilation would be a minimum recommendation. In addition, patrons should use caution and closed windows in extended garage idling situations.

III. AIR QUALITY MITIGATION MEASURES

Mitigation thresholds for potential air quality impacts are described and classified by type of project in the BAAQMD Assessment Guidelines (Ref 8). From Table IX-B-3, the San Jose Arena project is below the Category C mitigation threshold for planning actions affecting any facility generating more than 5,000 vehicles.

Measures relevant to the Sports Arena, taken from the full range of potential air quality mitigation measures described in detail in Section IX of the new BAAQMD Guidelines, are summarized in the following paragraphs. The recommended mitigations should be given serious consideration for implementation by the City of San Jose planning and development review agencies. The recommended transportation-related mitigations should be considered by both City and Santa Clara County transportation planning agencies.

A. PHYSICAL FACILITIES to support improvements in transit and flow of traffic.

1. Bicycle and Pedestrian Facility Improvements. Includes pedestrian pathways, safe bicycle routes and secure bicycle storage facilities.

2. Transit Improvements and Amenities. Additional transit stops, bus turnouts and shelters, passenger amenities, and special bus and carpool lanes.

3. Street And Traffic Flow Improvements. Traffic engineering changes which improve traffic flow, such as more lanes, turning lanes, and demand signalization of intersections, can make significant improvements; an average vehicle speed increase of 5 mph can achieve a 20% reduction in CO and hydrocarbon emissions.

4. Site Plan Changes for better traffic flow.

B. TRANSPORTATION-RELATED MANAGEMENT ACTIONS to encourage single-occupant patrons to switch to either public transit or multiple- passenger vehicles.

1. Transit Incentives and Agreements to improve project/transit interactions, such as improved routes and schedules to serve the project.

In practice, the effectiveness of any mitigation measure is directly proportional to reductions in traffic flow congestion and to the number of drivers that are willing to give up single-occupant travel. Actual reductions in emissions vary between 1 to 15% depending upon the measure. Clearly, the effectiveness of transportation alternatives is improved as the alternatives are made more attractive to drivers relative to travel in single-occupant vehicles. More detailed coverage of vehicular emission mitigation measures and associated benefits are presented in Section IX of Reference 10.

IV. UNAVOIDABLE AIR QUALITY IMPACTS WHICH CANNOT BE FULLY MITIGATED

1. Significant increases in CO concentrations near congested intersections and parking lots during arrival and departure of Sports Arena patrons under poor atmospheric conditions.

2. High exposures to CO inside Sports Arena parking garage during event arrival and departure periods.

AIR QUALITY REFERENCES

BAY AREA CLIMATOLOGY

1. Felton, E.L., California's Many Climates, Pacific Books, Palo Alto, 1965.

2. Gilliam, H., Weather of the San Francisco Bay Region, University of California Press, Berkeley, 1962.

AIR QUALITY

3. "Contaminant and Weather Summary", monthly station monitoring data, Bay Area Air Quality Management District, San Francisco.

4. Annual summaries of station air quality data, BAAQMD, San Francisco.

MODELING

5. Benson, Paul, CALINE 3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, Report No. FHWA/CA/TL - 79/23, California Dept. of Transportation, Sacramento, Nov 1979. IBM-based computer program by California Air Resources Board.

6. Turner, D. Bruce, Workbook of Atmospheric Dispersion Estimates, AP-26, U.S. Environmental Protection Agency, 1970.

7. "ENV028" computer program to determine annual composite vehicle emission rates, based upon "EMFAC 6D" vehicle-specific emission rate program, California Air Resources Board, Sacramento.

8. Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans, Planning Division, Bay Area Air Quality Management District, San Francisco, November 1985.

9. 1982 Bay Area Air Quality Plan, Association of Bay Area Governments (with Metropolitan Transportation Commission and BAAQMD), Berkeley, Dec 1982.

10. Guidelines for AQ Maintenance Planning and Analysis, Volume 9 (Revised): Evaluating Indirect Sources, Report EPA-450/4-78-001, U.S. Environmental Protection Agency, Research Triangle Park, NC, Sept 1978.

APPENDIX

COMMON AIR QUALITY TERMS AND DEFINITIONS

Air basin or airshed - a region which, due to its geography and topography, tends to contain air pollutants emitted within it.

Air pollutant - a substance in the atmosphere which is harmful or undesirable.

Air quality - the amount of pollutants in the air relative to existing ambient air quality standards*.

Air Resources Board (ARB) - California agency responsible for state air quality planning and control program.

Ambient Air Quality Standards - exposure limits established for various air pollutants by state and federal agencies.

Bay Area Air Quality Management District (BAAQMD) - nine-count y agency responsible for air quality planning and control in the San Francisco Bay area.

Carbon monoxide (CO) - an odorless and invisible gas pollutant produced primarily by vehicle operation. Reduces oxygen-carrying capacity of the blood, causing headache, fatigue, coordination disfunction, and cardio-respiratory stress.

Concentration - the amount of a pollutant in a given volume or sample of air.

Department of Environmental Protection (NDEP) - Nevada agency responsible for state air quality planning and control programs.

Dispersion - the process of mixing, dilution, and transport of air pollutants.

Emission - discharge of a substance into the air.

Environmental Protection Agency (EPA) - federal agency with overall responsibility for national and state air quality planning and control programs.

Hydrocarbons (HC) - a large group of compounds containing hydrogen, carbon and various other elements, and found in fossil fuels, paints and solvents. They cause plant damage, odor, and contribute to smog* formation.

Inversion - a reversal of the normal temperature lapse rate* in the atmosphere, producing a stable high-temperature layer above a lower-temperature layer.

Line source - a linear group of pollutant emitters, such as vehicles on a roadway.

Micrograms per cubic meter ($\mu g/m^3$) - a common unit of measurement of particulate concentration* in weight per unit volume.

Mixing layer - when an atmospheric temperature inversion* exists, the layer of air below the inversion altitude in which air pollutants are confined.

Modeling - a technique of using estimated source emissions and meteorological information to compute expected air pollutant concentrations.

Monitoring - regular measurement of air pollutant concentrations.

Nitrogen oxides (NO_x)- formed during high-temperature combustion processes, several gaseous pollutants cause plant damage, eye and lung irritation, and discoloration of materials. Nitrogen dioxide causes the typical brown color of smog.*

Odor - can be aesthetically unpleasant, and cause illness in some cases. Common problem gases include hydrogen sulfide, ammonia, and some organic vapors.

*defined elsewhere

Organic compounds - a very large group of substances containing carbon,found in all living matter, and also fossil material such as coal and petroleum. They are often released when extracted, processed, and/or burned.

Oxidants - a highly-active group of chemicals (mostly ozone in air) formed in the atmosphere by the photochemical reaction* of hydrocarbons*, nitrogen oxides*, and sunlight. Causes extensive vegetation damage, eye irritation, headache, and impaired breathing.

Ozone (O_3) - see Oxidants above.

Particulates, total suspended (TSP) - include solid particles, dust, and smoke, and are produced by industrial processes, combustion, and vehicles. They damage plants and materials, reduce sunlight and visibility, and carry irritating chemicals into the respiratory system.

Parts per million (ppm) - a common unit of measurement of gaseous pollutant concentration in relative volume of pollutant per million volumes of air.

Photochemical reaction - the atmospheric combination of hydrocarbons* and oxides of nitrogen to form oxidants* and smog*, driven by the energy from intense sunlight.

Point source - a single stationary souce of air pollution.

Primary air quality standards - recommended limits to air pollutant concentrations based upon criteria for protection of human health.

Secondary air quality standards - recommended limits to air pollutant concentrations based upon criteria for protection of property and aesthetics.

Smog - the combination of air pollutants found during intense photochemical reaction.*

Source - a process, activity, or machine which emits air pollution.

Stagnation - an extremely stable atmospheric condition in which little vertical or horizontal dispersion* of emitted pollutants occurs.

Sulfur oxides - are produced by processing and combustion of fossil fuels which have sulfur content. These gaseous pollutants are toxic to plants, deteriorate materials, and in combination with particulates, contribute to serious respiratory illness.

Temperature lapse rate - the normal atmospheric temperature profile which decreases as altitude increases. See Inversion*.

Transport - the movement of emitted pollutants by wind or thermal action.

Visibility reduction - is caused by suspended very small particles, water vapor, smoke, and gases with color.

*defined elsewhere

Appendix DRAFT

(TO BE INSERTED BY D.P.A.)

A-3

APPENDIX

CALINE 3 VARIABLE DESCRIPTIONS

SITE VARIABLES

Run	title of modeling run
U	wind speed (m/sec)
MIXH	atmospheric mixing height (m)
ZO	measure of roughness of surface topography (cm)
BRG	wind direction (degrees)
ATIM	averaging time (min)
VS	settling velocity (cm/sec)
CLASS	atmospheric stability class 1 = least stable, 6 = most stable
AMB	ambient concentration (set to zero to highlight project contributions)
VD	deposition velocity (cm/sec)

LINK VARIABLES

1,2,...	link (street segment) numbers
X,Y	link end coordinates
TYPE	link type: AG= at grade, FL= fill, BR= bridge, DP= depressed
VPH	traffic volume (vehicles/hour)
EF	composite emission factor (gms/mi)
H	link height (m)
W	street width (m)

RECEPTOR COORDINATES

1,2,3...	receptor number
X,Y,Z	receptor coordinates, elevation

MODEL RESULTS

CO/LINK	CO contributions by link
TOTAL	total concentration at receptor

CALINE3
RUN :(1) SAN JOSE ARENA SITE B

1.0 SITE VARIABLES

U= 2 M/S BRG= 90 DEGREES CLASS= 6
MIXH= 1000 M ATIM= 60 MINUTES AMB= 0 PPM
Z0= 100 CM VS= 0 CM/S VD= 0 CM/S

2.0 LINK VARIABLES

LINK	LINK COORDINATES (M) X1	Y1	X2	Y2
1	48	2977	569	2797
2	569	2797	1078	3097
3	1078	3097	1420	2696
4	1420	2696	2037	1683
5	431	3582	952	2941
6	952	2941	1222	2378
7	1222	2378	1689	916
8	-240	1989	485	2025
9	485	2025	707	2198
10	707	2198	1294	2402
11	1294	2402	1420	2696
12	1078	1833	2132	2444
13	-1120	2935	-54	1785
14	-54	1785	1078	1833
15	539	2402	881	2007
16	881	2007	940	1282
17	1462	2043	1767	1539
18	970	2055	940	1282
19	-347	3013	665	1815
20	-990	2192	1569	4043

CALINE3
RUN :(1) SAN JOSE ARENA SITE B

LINK	LINK DESCRIPTORS TYPE	VEH	EF	H	W
1	AG	1500	18.1	0	20.7
2	AG	2740	18.1	0	20.7
3	BR	2800	18.1	5	20.7
4	AG	2400	18.1	0	20.7
5	AG	2500	14.3	0	24
6	BR	0	0	9	24
7	BR	2530	14.3	7	27.6
8	AG	540	21.3	0	13.4
9	AG	1170	21.3	0	13.4
10	AG	1900	18.1	0	13.4
11	AG	2400	18.1	0	13.4
12	AG	1900	18.1	0	20.7
13	AG	2660	18.1	0	20.7
14	AG	1930	.18.1	0	20.7
15	AG	280	21.3	0	17
16	AG	430	21.3	0	17
17	AG	2230	21.3	0	24
18	AG	1000	21.3	0	17
19	AG	940	19	0	18.2
20	AG	1590	18.1	0	20.7

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	X	Y	Z
1	1192	2983	1.3
2	270	2025	1.3
3	719	2223	1.3

4.0 MODEL RESULTS

RECEPTOR	CO/LINK 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL PPM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	.3	0	0	0	.1	0	0	0	0	0	0	0	0	.4
3	0	0	0	0	0	0	0	0	0	.7	0	.1	0	0	0	0	0	0	0	0	.8

CALINE3

RUN :(4) SAN JOSE ARENA SITE B

1.0 SITE VARIABLES

U= 2 M/S BRG= 225 DEGREES CLASS= 6
MIXH= 1000 M ATIM= 60 MINUTES AMB= 0 PPM
Z0= 100 CM VS= 0 CM/S VD= 0 CM/S

2.0 LINK VARIABLES

LINK *	LINK COORDINATES (M) X1	Y1	X2	Y2
1	48	2977	569	2797
2	569	2797	1078	3097
3	1078	3097	1420	2696
4	1420	2696	2037	1683
5	431	3582	952	2941
6	952	2941	1222	2378
7	1222	2378	1689	916
8	-240	1989	485	2025
9	485	2025	707	2198
10	707	2198	1294	2402
11	1294	2402	1420	2696
12	1078	1833	2132	2444
13	-1120	2935	-54	1785
14	-54	1785	1078	1833
15	539	2402	881	2007
16	881	2007	940	1282
17	1462	2043	1767	1539
18	970	2655	940	1282
19	-347	3013	665	1815
20	-990	2192	1569	4043

CALINE3

RUN :(4) SAN JOSE ARENA SITE B

LINK *	LINK DESCRIPTORS TYPE	VPH	EF	H	W
1	AG	1620	17	0	20.7
2	AG	1460	17	0	20.7
3	BR	1500	17	5	20.7
4	AG	2200	17	0	20.7
5	AG	2950	12.3	0	24
6	BR	2500	12.3	9	24
7	BR	2550	12.3	7	27.6
8	AG	790	19.4	0	13.4
9	AG	1700	19.4	0	13.4
10	AG	2670	16.5	0	13.4
11	AG	2500	16.5	0	13.4
12	AG	2140	16.5	0	20.7
13	AG	2930	16.5	0	20.7
14	AG	2110	16.5	0	20.7
15	AG	670	19.4	0	17
16	AG	620	19.4	0	17
17	AG	1880	19.4	0	24
18	AG	970	19.4	0	17
19	AG	1050	17	0	18.2
20	AG	1780	16.5	0	20.7

3.0 RECEPTOR COORDINATES (M)

RECEPTOR *	X	Y	Z
1	1192	2983	1.3
2	270	2025	1.3
3	719	2228	1.3

4.0 MODEL RESULTS

RECEPTOR *	CO/LINK 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL PPM
1	0	0	.1	0	0	.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.2
2	0	0	0	0	0	0	0	.3	0	0	0	0	0	.1	0	0	0	0	0	0	.4
3	0	0	0	0	0	0	0	0	1	0	0	0	0	.1	.1	0	0	0	0	0	1.2

CALINE3

RUN :(6) SAN JOSE ARENA SITE B

1.0 SITE VARIABLES

```
     U=  2  M/S     BRG=  90  DEGREES   CLASS=  6
 MIXH=  1000  M ATIM=  60  MINUTES     AMB=  0  PPM
   ZO=  200  CM     VS=  0  CM/S        VD=  0  CM/S
```

2.0 LINK VARIABLES

LINK	X1	Y1	X2	Y2
1	48	2977	569	2797
2	569	2797	1078	3097
3	1078	3097	1420	2696
4	1420	2696	2037	1683
5	431	3582	952	2941
6	952	2941	1222	2378
7	1222	2378	1639	916
8	-240	1989	485	2025
9	485	2025	707	2198
10	707	2198	1294	2402
11	1294	2402	1420	2696
12	1078	1833	2132	2444
13	-1120	2935	-54	1785
14	-54	1785	1078	1833
15	539	2402	881	2007
16	881	2007	940	1282
17	719	2827	970	2055
18	970	2055	940	1282
19	-347	3013	665	1815
20	-990	2192	1569	4043

LINK COORDINATES (M)

CALINE3

RUN :(6) SAN JOSE ARENA SITE B

LINK DESCRIPTORS

LINK	TYPE	VPH	EF	H	W
1	AG	2100	13.9	0	20.7
2	AG	1550	13.9	0	20.7
3	BR	1530	13.9	5	20.7
4	AG	1450	13.9	0	20.7
5	AG	6020	10.3	0	24
6	BR	6060	10.3	9	24
7	BR	6080	10.3	7	27.6
8	AG	1150	16.3	0	13.4
9	AG	1030	16.3	0	13.4
10	AG	2190	13.9	0	13.4
11	AG	2700	13.9	0	13.4
12	AG	2930	13.9	0	20.7
13	AG	2300	13.9	0	20.7
14	AG	1640	13.9	0	20.7
15	AG	800	16.3	0	17
16	AG	750	16.3	0	17
17	AG	900	14.1	0	21.5
18	AG	1050	16.3	0	17
19	AG	410	14.5	0	18.2
20	AG	2080	13.9	0	20.7

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	X	Y	Z
1	1192	2983	1.3
2	270	2025	1.3
3	719	2228	1.3

4.0 MODEL RESULTS

CO/LINK

RECEPTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL PPM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	.1	.5	0	0	0	.1	0	0	0	0	0	0	0	0	.7
3	0	0	0	0	0	0	.1	0	0	.6	0	.1	0	0	0	0	0	0	0	0	.8

APPENDIX B-3

ACOUSTICAL ANALYSIS

EDWARD L. PACK ASSOCIATES, INCORPORATED

SANTA CLARA, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

EDWARD L. PACK ASSOCIATES, INC.

Consulting Engineers

TELEPHONE (408) 727-6840

2940 SCOTT BOULEVARD
SANTA CLARA, CALIF 95054

July 28, 1987
Project No. 19-047

Mr. David Powers
David J. Powers Associates
1885 The Alameda, Suite 210
San Jose, CA 95126

Subject: Roadway, Railroad, and Aircraft Noise Assessment Study for the Proposed Arena, Site "B", Downtown San Jose

Dear Mr. Powers:

This report presents the results of a noise assessment study for a proposed arena on Site B in downtown San Jose, as shown on the Site Plan, Ref. (a), and on Figure 1, herein. Site "B" is one of three alternative locations being considered for an arena, and one of two locations in the downtown San Jose area. The assessment reported herein includes a description of the existing acoustical environment, results of noise level measurements, noise impacts that would result from the proposed project, a discussion of the applicable noise standards, and mitigation measures required to achieve compliance with the standards. Attached hereto are Appendices A and B, which include the list of references, a discussion of the applicable standards, terminology and a description of the instrumentation used for the field survey.

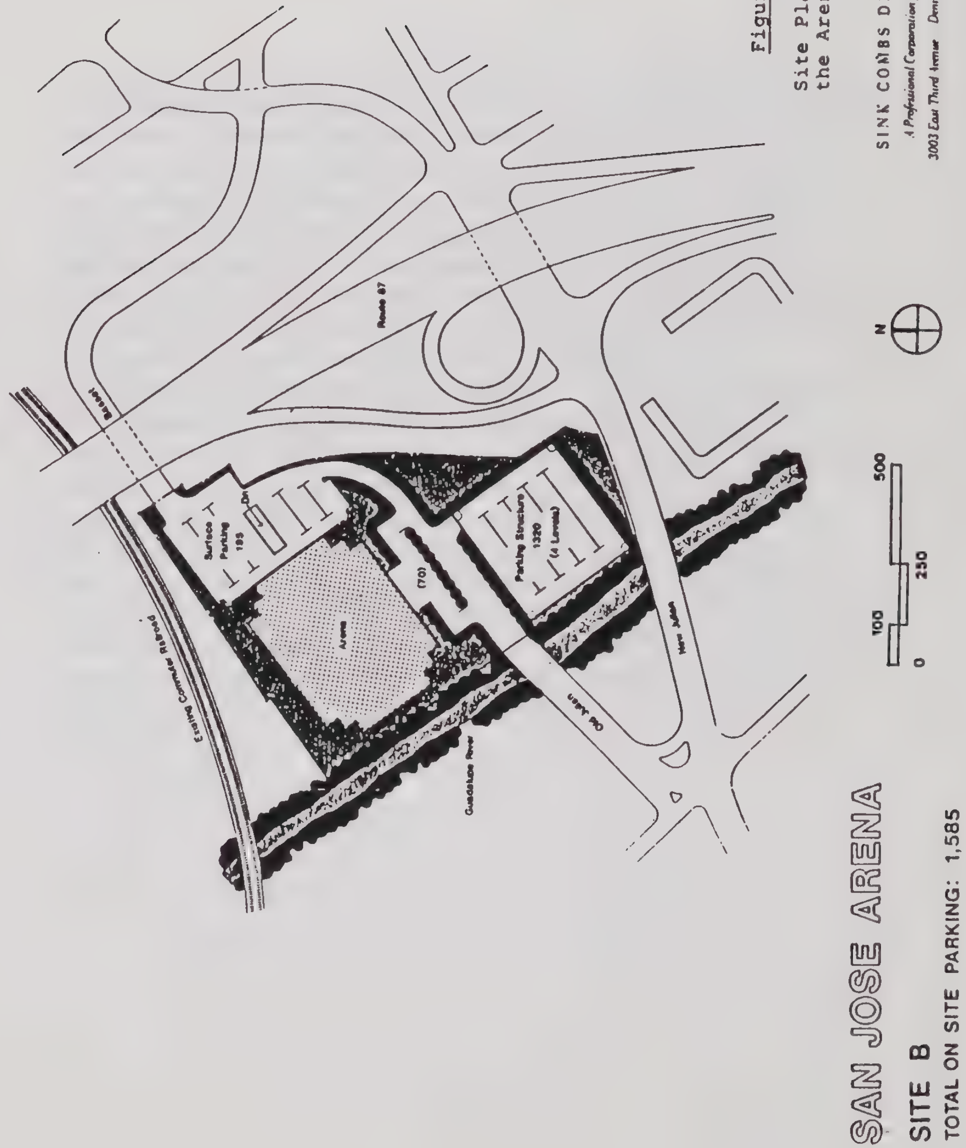


Figure 1.
Site Plan for the Arena, Site "B".

I. Acoustical Setting

A. Description of the Study Area

The arena site currently called Site B is located in the downtown area of the City of San Jose, and is bounded by the Southern Pacific Railroad to the north, Julian Street to the south, the Guadalupe River to the west, and the Guadalupe Freeway (SR 87) to the east. The existing land use is industrial.

The San Jose General Plan, Ref. (b), designation for the site is industrial/commercial, except for an open space corridor following the Guadalupe River drainage channel. The existing zoning district for the site is industrial (M-1 and M-4). Surrounding areas are zoned for industrial, commercial and residential land uses.

B. Existing Noise Levels

To determine the existing noise environment, continuous recordings of the sound levels were taken at two locations bordering the site, and at seven locations in the surrounding area. The measurement locations and recorded data are presented in Table I, below. The measurements were made on February 3, 4, May 19 and 27, and June 2 and 12, 1987. The recordings were made with a Gen Rad Company Community Noise Analyzer, which yielded a series of descriptors of the sound levels versus time. The descriptors shown in the table are the L_{10}, L_{50} and L_{90}, i.e., those levels that are exceeded 10%, 50% and 90% of the time. Also shown are the maximum and

minimum levels, and the continuous equivalent level (L_{eq}). In addition to these measured levels, the day-night level (L_{dn}, and the Community Noise Equivalent Level (CNEL), as specified by the San Jose Noise Element and Santa Clara County Airport Land Use Commission standards, respectively, are shown for five measurement locations. The L_{dn} and CNEL are 24 hour noise descriptors used to define community noise levels and are considered to be approximately equivalent. These descriptors are calculated using the L_{eq} values with the formulae given in Appendix B. Weighting factors are applied in the formulae for the evening and nighttime periods to account for an increased sensitivity to noise during these hours. The measurements at the two on-site locations (Julian Street and Bassett Street), and at the Coleman Avenue, W. Santa Clara Street, and Stockton Street locations were made for a total period of 3 hours at each location, with two hours measured in the daytime period and one hour measured in the evening or nighttime period. The Martin Avenue and Hanchett Street locations were measured for one hour each in the evening period, when weekday arena traffic would be most likely to impact residential areas in the project vicinity.

TABLE I

Noise Levels Measured at the Proposed Arena "B" Site and Environs

Location and Time Period	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}	L_{eq}
38 Ft. from the C_L of Stockton Avenue, 500 Ft. North of The Alameda:						
3:00 - 4:00 pm	87	67	60	64	47	64
4:00 - 5:00 pm	94*	68	62	54	49	65
9:00 - 10:00 pm	80	69	60	54	50	65
The L_{dn}/CNEL is 69 dB						
50 Ft. from the C_L of the SPRR Tracks, Near San Pedro St.:						
3:00 - 4:00 pm	77	59	55	53	49	57
4:00 - 5:00 pm	75	59	55	53	48	57
5:00 - 6:00 pm	84**	63	55	53	49	63
The L_{dn}/CNEL is 65 dB						
40 Ft. from the C_L of Julian Street, West of the Guadalupe River:						
5:00 - 6:00 pm	91	73	65	59	51	70
6:00 - 7:00 pm	89	74	67	59	49	72
8:00 - 9:00 pm	94*	66	54	48	46	68
The L_{dn}/CNEL is 71 dB						
45 Ft. from the C_L of Santa Clara St.,West of Delmas Ave:						
10:00 - 11:00 am	79	70	64	59	53	67
11:00 am - 12:00 noon	99***	71	64	59	51	72
8:00 - 9:00 pm	87	67	60	57	54	66
The L_{dn}/CNEL is 66 dB						

TABLE I (Con't.)

Location and Time	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}	L_{eq}
42 Ft. from the C_L of Coleman Avenue, Opposite Hobson St.:						
3:00 - 4:00 pm	96***	76	67	57	51	73
4:00 - 5:00 pm	90	75	68	57	51	72
10:00 - 11:00 pm	87	68	56	50	45	67
The L_{dn}/CNEL is 75 dB						
At the Edge-of-Pavement of Hanchett Avenue, East of Tillman Avenue:						
8:00 - 9:00 pm	81	57	50	45	41	57
At the Edge-of-Pavement of Hanchett Avenue, East of Sequoia Avenue:						
8:00 - 9:00 pm	85	62	50	44	40	60
At the Edge-of-Pavement of Martin Avenue, East of Sequoia Avenue:						
7:00 - 8:00 pm	83	57	46	42	39	65

Note: Highest maximum levels due to:

- * Aircraft flyby
- ** Train Passby
- *** Emergency siren

The existing noise environment at Site "B" is controlled by roadway traffic, SPRR train passbys and aircraft approaching the San Jose International Airport (SJIA). Roadway traffic noise from Julian Street impacts the southern portion of the site. Railroad noise impacts are due to train sources on the Milpitas line tracks at the northern edge of the site, which carry 3 SPRR freight trains per day. Aricraft landing at SJIA follow a flight path directly west of the site, which produce noise levels of 65 to 67 dB CNEL.

In surrounding areas, SPRR train noise also affects the area east of Stockton Street, where the main line tracks provide service for passenger, commute, and freight trains. Aircraft noise is also prevalent in the surrounding area with noise levels of 60 to 70 dB CNEL commonly occurring, as shown by the noise contour map of Ref. (c). Roadway traffic noise impacts occur along the major thoroughfares: The Alameda/W. Santa Clara Street, Julian Street, Stockton Street and Coleman Avenue.

The calculated L_{dn}/CNEL values shown in Table I reflect noise produced by all of the above described sources, either singly or in combination, depending on the proximity of the measurement location to each source. The L_{dn} and CNEL values were calculated using a decibel average of the measured daytime, evening and nighttime L_{eq} values, as shown in Appendix B. Adjustments were included for average roadway, railroad and aircraft traffic conditions. Where necessary, nighttime L_{eq} values were estimated using procedures developed in Refs. (d) and (e), for roadway and train traffic, respectively. The noise contour map for the SJIA, shown in Ref. (c), was also used in the noise level estimates. Thus, the calculated L_{dn}/CNEL values

reveal existing noise levels at the arena Site B varying from 71 dB L_{dn} at the Julian Street location to 65 dB L_{dn} at the Bassett Street location. Along major roadways in the site vicinity, L_{dn} values varied from 66 dB along W. Santa Clara Street to 75 dB along Coleman Avenue. Measured L_{eq} values in residential areas varied from 57 dBA at a Hanchett Street location to 65 dBA at the Martin Avenue locations.

Maximum intermittent noise levels (L_{max}) from aircraft sources recorded at the site are up to 94 dBA, with the highest maximum from an aircraft flyby recorded at the Julian Street location. Higher maximum noise levels shown in Table I are from SPRR train passbys and from emergency vehicle sirens.

C. <u>Noise Standards</u>

The noise compatibility standards for public buildings and recreational uses, including arenas, are contained in the Noise Element of the San Jose General Plan, Ref. (b). The standards specify a level of up to 60 dB L_{dn} as "acceptable with restrictions", and a level of 70 dB L_{dn} or higher as "generally unacceptable".

As shown in Ref. (c), the site is also located within the 65 dB CNEL contour for aircraft noise from SJIA, and thus falls under the jurisdiction of the Santa Clara County Airport Land Use Commission (ALUC). This agency makes recommendations and sets policies for development within areas impacted by aircraft operations. The ALUC land use compatibility guidelines for recreational uses, including arenas, specify a level of up to 60 dB CNEL as "satisfactory", a level of 67 to 75 dB CNEL as "cautionary", and areas of 75 dB CNEL or higher to be avoided for these uses, "unless related to airport service". The ALUC guidelines also specify a maximum intermittent interior noise level of 75 dBA for sports arenas.

II. Impacts

The proposed arena Site B project includes construction of an arena, a 4-level parking structure, and surface parking for 195 vehicles. Project-generated noise impacts involve increased traffic flows on the main streets surrounding the site, noise from inside the arena, and the construction phase noise impacts, as discussed below. Also discussed are traffic noises impacting the arena.

A. Project-Generated Impacts

1. Traffic noise

Project-generated traffic noise impacting the surrounding area will be created when the arena is being used. Increases in roadway traffic due to arena use would occur mostly during the evening and nighttime hours (4:00 p.m. to 12:00 midnight), and on weekends, which will be referred to herein as the arena peak hour traffic. These impacts will also be considered in the context of the L_{dn} and CNEL (i.e., over a 24-hour period) in relation to existing and future roadway, railroad and aircraft sources.

By the Year 1991, when the arena is completed, railroad operations on the SPRR Milpitas line are expected to remain the same as existing volumes. By the Year 2000, up to 2 additional freight trains will be using the tracks near the site, as reported in Ref. (g). Increases in rail traffic will also occur along rail lines in the surrounding area, as reported in Ref. (h).

Aircraft noise levels are expected to remain the same as existing levels or decrease through the Year 2000, as reported by the Noise Control Officer for SJIA, Ref. (i).

Increases in roadway traffic noise are estimated for both Year 1991 and Year 2000 conditions by comparing Average Daily Traffic (ADT) volumes for these years against the existing ADT, as provided by the traffic consultant for the project, Ref. (j).

Increases in the calculated L_{dn}/CNEL from all three traffic sources for both Year 1991 and Year 2000 conditions are shown in Table II. The existing levels are also given for comparison. The future levels are given with and without the arena and are kept separate in order to evaluate the contribution from the arena traffic alone. Although roadway traffic volumes increase significantly, the resulting L_{dn}/CNEL levels due to roadway, railroad and aircraft sources do not increase significantly over existing levels.

The locations shown in Table II correspond to the measurement locations shown in Table I, except for Riverfront Road, which is shown for Year 2000 only when the road will be completed.

TABLE II

Roadway, Railroad and Aircraft Traffic Noise
Levels for Existing and Future Conditions,
With and Without the Proposed Arena

Location*	Existing	Year 1991 w/o Arena	Year 1991 w/Arena	Year 2000 w/o Arena	Year 2000 w/ Arena
	Noise Levels (dB L_{dn}/CNEL)				
Julian St.	71	72	72	74	74
Santa Clara St.	66	67		67	67
Coleman Ave.	75	75	75	77	77
Stockton St.	69	71	71	68	68
Bassett St.	65	68	68	68	68
Riverfront Rd. (future only)	--	--	--	67	68

* Locations correspond to measurement location in Table I.

The impact created by the increases in the future levels over existing levels can be assessed using the following criteria developed by the Environmental Protection Agency.

Predicted Impact From Increase Over Existing Noise Levels

Increase in Levels	Assessment	Expected Response
Less than 6 dBA	No Impact	Little comment or individual reaction
6 to 14 dBA	Some Impact	Some individual comment and reaction, no group action is likely
More than 14 dBA	Great Impact	Strong Individual comment and group action

Based on these criteria, it is evident that the noise level increases will have little or no impact on the surrounding areas of the arena site, whether due to general traffic increases or to project-generated traffic.

In addition to the above evaluation, which is in terms of the 24-hour noise analysis, the arena peak hour traffic noise impacts must be considered. While the L_{dn}/CNEL impacts will be minimal, the traffic increases during the times when the arena is being used may create significant noise level increases, especially during the quieter evening and nighttime hours. These predicted increases in the noise levels during the periods when the arena would be in use are shown in Table III. As shown in the table, arena traffic would generate noise levels up to 7 dBA higher than non-arena traffic levels at some locations. In reference to the noise impact criteria given above, arena traffic noise levels would have "some impact" at the Julian Street measurement location.

TABLE III

Noise Level Increases for Measurement Locations During Arena Peak Hour Traffic Periods

Location		Noise Level Increases, dBA	
	Year:	1991	2000
1. Julian Street		2 - 7	1 - 5
2. Santa Clara Street		3	1 - 3
3. Coleman Avenue		3 - 4	1 - 2
4. Stockton Street		2 - 3	decrease
5. Bassett Street		0	0
6. Hanchett Street		2 - 3	1 - 2
7. Martin Avenue		0	0

As shown, when compared with the L_{dn}/CNEL noise level increases of Table II, it is evident that the arena peak hour traffic noise impacts will be more noticeable than the daily average impacts.

Two other factors that must be considered are the noise level impacts in reference to the applicable standards, and the impacts in terms of the types of land uses that will be affected.

The arena site and the general area surrounding it are already subjected to high noise levels, even for commercial and industrial land uses. Thus, any increase over the existing ambient levels will add to an existing excessive noise environment.

Even though the noise standards apply only to new development, they provide a good general indication of compatible noise levels for existing land uses as well. Consequently, any development located along major thoroughfares, whether existing or proposed, will be impacted by the arena traffic noise.

The area surrounding the site is mostly designated for industrial or commercial land uses, which are usually exposed to higher noise levels than residential areas, and thus, are more tolerant of noise level increases. Therefore, the impacts on these areas will not be significant, especially when considering that the arena traffic impacts will occur at night and on weekends, when many of these uses are non-operative. There is also an area of residential land use along The Alameda that would be impacted by project traffic. Two residential streets (Hanchett Street and Martin Avenue) have been included in the evaluation for Table III, which shows that increases for Hanchett Street of 2 to 3 dB in the ambient noise level could occur during the periods of heavy arena traffic. Thus, based on the impact table, noise level impacts on these residential streets is expected to be minimal. The predicted impacts on other residential streets is expected to be minimal, however, the actual traffic flows using these residential streets is difficult to project with any accuracy using available modeling techniques, as reported by the traffic engineer, Ref. (k). Thus, for purposes of this report, it is assumed that most of the arena traffic would use the major thoroughfares for ingress and egress to the arena, thereby leaving residential streets free of arena traffic. However, several of the

intersections may become so congested during periods of heavy arena traffic that some vehicles may try to bypass the main traffic flow by using parallel residential streets. This would in turn create noise impacts along these streets. An accurate prediction of the impacts on these surrounding streets is not available at this time.

2. Arena Sound Impacts

The preliminary site plan for Site B shows an arena with a floor area of approximately 160,000 sq. ft. With a floor-to-ceiling height of 40 to 50 feet, the total volume of the arena would be in the range of 6,400,000 to 8,000,000 cu. ft. Arenas of this size fall into the "large" category, and require large speaker systems capable of handling several thousand watts of audio power. Typical audience area levels of 110 dBA will be created at times. Thus, a potential for disturbance will exist in the areas surrounding the arena.

The greatest potential for disturbing the surrounding community would be from a roofless structure which would allow sound to escape unimpeded. If a pneumatic structure utilizing a flexible outer skin supported by air is used, sound insertion losses of 25 to 30 dB are attainable, depending on the fabric. Various types of coated fabrics have been used with weights ranging from 400 to 3,700 grams per sq. meter. Material surface weights of this range will yield sound attenuation of 25 to 30 dB at 500 Hertz sound frequencies. Thus, arena interior sound levels of 110 dBA would be reduced to 80-85 dBA in the near field and to 60-65 dBA at 500 foot distances.

An arena roof of fixed or movable design would reduce noise by a minimum of 30 dB for roof surface weights of 1.0 pound per square foot or more. Thus, such types of roof and wall structures will be adequate for reducing noise escape from the arena. However, noise intrusion from aircraft sources has low frequency components and this factor must be considered in the design of the arena shell.

3. Construction Phase Impacts

During the construction phase of the project, high noise levels in the site vicinity may temporarily be created. The site preparation and construction phases will generate sound levels ranging from approximately 70 to 90 dBA at 50 foot distances from heavy equipment and vehicles. The construction vehicles and equipment generally are diesel powered and produce a characteristic noise which is primarily concentrated in the lower frequencies. Engine noise typically predominates, but additional noise originates from fans and transmission systems.

The total noise energy impacting a receptor point is dependent on the work phases of the construction process, on the distance, and on the angle subtended by the work processes at the noise receptor locations.

The powered equipment and vehicles act as point sources of sound which will diminish with distance over open terrain at the rate of 6 dBA for each doubling of the distance from the source. For example, the 70 to 90 dBA equipment peak noise range at 50 feet will reduce to 64 to 84 dBA at 100 feet, and from 58 to 78 dBA at 200 feet. Therefore, during the

construction operations, sound level increases of up to 19 dBA due to these sources could occur near the project boundary.

B. Noise Impacting the Proposed Project

In reference to the standards of the City of San Jose Noise Element and the Santa Clara County ALUC, as shown in Appendix B, construction of an arena on the Site "B" would result in exposure of a publicly used building to excessive levels of noise. Levels measured at or near the project site resulted in L_{dn}/CNEL's of up to 71 dB, and maximum levels of up to 94 dBA were recorded for aircraft overflights. In general, noise levels of 65 to70 dB L_{dn}/CNEL are common over the entire site. Thus, under the City of San Jose standards, placement of the arena at this location would be "acceptable with restrictions", i.e., locating the arena at this site is acceptable on the condidion that noise control measures are incorporated into the design. Under the ALUC standards, an arena would be a "cautionary" land use, which also indicates that acoustical measures are required to be incorporated into the building design for aircraft noise. Also, maximum levels of 94 dBA from aircraft would result in a 19 dBA excess over the recommended maximum interior level of 75 dBA of the ALUC standards. Noise levels of up to 85 dBA (maximum) from railroad operations would also impact the site.

Therefore, mitigation measures for the arena will be required to reduce noise to acceptable levels. These measures are described in Section III, below.

III. Mitigation Measures

A. Project - Generated Noise

1. Traffić Noise Impacts

Under the criteria for assessment of impacts, project-generated traffic noise will not be significant in terms of the applicable city and county standards. However, during periods of peak arena traffic, noise impacts may occur at nearby residential areas.

Mitigation of these impacts is difficult to achieve with the resources normally available. However, some form of mitigation, such as the use of barricades to block non-arterial residential streets, may help to reduce traffic flows into these areas and maintain the concentration of noise impacts along major thoroughfares, where their impact is not likely to be as severe.

2. Arena Noise Emission Mitigation

Noise impacts generated from within the arena, i.e., crowds, loudspeaker systems, and other sources, will vary in intensity depending on the type of roof used for the structure. Sounds emanating from the arena will be greatest for an open air structure, and the most shielding will be provided by a solid roof structure. Therefore, it is recommended that the arena have, as a minimum, an inflatable or supported fabric roof to contain sounds within the immediate site vicinity.

A solid roof structure (i.e., made with roofing materials having a surface density of 1.0 or more lbs. per sq. ft. on a rigid framework) would provide the most noise shielding for the surrounding areas, and would thus be the more favorable alternative.

It is also recommended that any openings in the arena structure, such as windows, ventilation shafts, or skylights, be designed as controlable openings, so that they are acoustically effective. during periods when the arena is in use, and interior-to-exterior sound transmission can be kept to a minimum.

B. Mitigation of Noise Impacts on the Arena

The ambient noise levels at the site preclude the use of an open air arena. A roof design of adequate mass with controls on any openings is required to achieve compliance with the standards. The following measures are recommended to achieve maximum noise control for the arena:

- The arena should be designed to achieve a minimum building shell insertion loss of Sound Transmission Class (STC) 30. This rating applies to the roof, walls, windows, doors and all other building shell elements providing a barrier for exterior-to-interior noise transmission.

- No permanent, significant openings should be included between the exterior and interior seating spaces. Thus, some form of mechanical ventilation should be provided. Windows, which may be operable, and doors should provide the STC 30 rating in the closed position. These elements should be maintained closed when the arena is in use. Vestibules may be used for doors requiring more direct access to the exterior.

C. Construction Noise Mitigation

Mitigation of the construction phase noise at the site can be accomplished by using quiet or "new technology" equipment. The greatest potential for noise abatement of current equipment is the quieting of exhaust noises by use of improved mufflers. Therefore, it is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer. In addition, all equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engine, drive-train and other components.

In addition to the source emission controls, mitigation of construction noise can also be achieved by:

- Scheduling noisy operations for the daytime hours of 7:00 a.m. to 7:00 p.m. to avoid the more noise-sensitive evening and nighttime hours.

A noise reduction benefit can also be achieved by appropriate selection of equipment utilized for various operations, subject to equipment availability and cost considerations. Noise levels should be a consideration in the selection of construction equipment and methods.

The above report presents our noise study findings and recommendations for the planned arena, Site "B", in San Jose. The study findings for existing traffic conditions are based on field measurements and other data and are correct to the best of our knowledge. The future noise level predictions are based on information provided by the traffic consultant, the Southern Pacific Transportation Company, Cal Trans, and the San Jose International Airport. Significant deviations in the predicted traffic volumes or future changes in motor vehicle or aircraft technology, noise regulations or roadway configurations may produce long-range noise results different from our estimates.

If any additional information or an elaboration of this report is required, please contact me at your convenience.

Respectfully submitted,

Edward L. Pack

Edward L. Pack, Sc.D., P.E.
Principal Acoustical Engineer

ELP:m

Attachment: Appendix A: References
Appendix B: Noise Standards, Terminology, and Acoustical Instrumentation

APPENDIX A

References:

(a) San Jose Arena, Site "B", by Sink Combs Dethlefs, Denver, Colorado, undated

(b) Noise Element of the General Plan, Horizon 2000, City of San Jose, Adopted by City Council, November 1984

(c) San Jose International Airport, Santa Clara County ALUC Referral Boundary (65 dB CNEL), May 1986

(d) Highway Research Board, "Highway Noise, A Design Guide for Highway Engineers", Report 117, 1971

(e) John J. Van Houten, "California Noise Insulation Standards", Noise Control Engineering, Volume 5, No. 2, September/October 1975

(f) Land Use Plan for Area Surrounding Santa Clara County Airports, Santa Clara County Airport Land Use Commission, August 1973

(g) Information on Existing and Future Freight Train Traffic Volumes Provided by Douglas Rockwell, Southern Pacific Railroad, by Telecon to Edward L. Pack Associates, Inc., June 27, 1987

(h) Information on Future Passenger Train Volumes Provided by Eric Schatmeier, Manager, Planning and Marketing, Cal Train, by Telecon to Edward L. Pack Associates, Inc., June 30, 1987

(i) Information on Future Air Traffic Volumes Provided by Daniel Slowinsky, Noise Control Officer, San Jose International Airport, by Telecon to Edward L. Pack Associates, Inc., June 26, 1987

(j) Information on Existing, Future and Project-Generated Traffic Volumes Provided by Barton-Aschman Associates, by Transmittal to Edward L. Pack Associates, Inc., June and July, 1987

References (Con't.)

(k) Information On Residential Street Traffic Volumes Provided by Maria Lu, Traffic Engineer, Barton Aschman Associates, by Telecon to Edward L. Pack Associates, Inc., July 23, 1987

APPENDIX B

Noise Standards, Terminology and Instrumentation

1. Noise Standards

A. San Jose Noise Element

The San Jose Noise Element uses the day-night level (L_{dn}) noise descriptor to quantify community noise environments. The standards regarding Public, Quasi-Public and Residential Land Uses (including arenas and parks), specify an exterior L_{dn} of up to 60 dB as "satisfactory". An exterior level of 60 to 70 dB L_{dn} indicates an acoustical analysis should be performed to reduce interior noise to acceptable levels, and outdoor activity is limited to acoustically protected areas. Above 70 dB L_{dn}, new development is permitted only if the use is entirely indoors, and if building design limits interior noise to acceptable levels.

B. Santa Clara County ALUC Standards

The Airport Land Use Commission of Santa Clara County specifies exterior levels of up to 65 dB CNEL as "satisfactory" for recreational uses, including arenas. Levels of 65 to 75 dB CNEL indicate "caution", i.e., noise insulation needs must be carefully reviewed. Above 75 dB CNEL, recreational land uses should be avoided "unless related to airport service". The ALUC also specifies a maximum intermittent noise level of 75 dBA for sports arenas. These standards utilize the Community Noise Equivalent Level (CNEL) descriptor, which is approximately equivalent to the day-night level.

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the Community Noise Analyzer. Some of the statistical levels used to describe community noise are defined as follows:

L_{10} - A noise level exceeded for 10% of the time, considered to be an "intrusive" level.

L_{50} - The noise level exceeded 50% of the time, representing an "average" sound level.

L_{90} - The noise level exceeded 90% of the time, designated as a "background" noise level.

L_{eq} - The continuous-equivalent level is that level of a steady noise having the same energy as a given time-varying noise. The L_{eq} thus represents the decibel level of the time-averaged value of sound energy or sound pressure squared. The L_{eq} is the noise descriptor used to calculate the L_{dn} and CNEL descriptors.

B. Day-Night Sound Level (L_{dn})

Noise levels utilized in the standards are described in terms of the day-night sound level (L_{dn}). The L_{dn} rating is determined by the cumulative noise exposures occurring over a 24 hour day in terms of A-weighted sound energy. The 24 hour day is divided into two subperiods for the L_{dn} index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m., and the nighttime period from 10:00 p.m. to 7:00 a.m. A 10 dBA weighting factor is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The L_{dn} is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$L_{dn} = [(L_d + 10 \log_{10} 15) \ \& \ (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24$$

where:

$L_d = L_{eq}$ for the daytime (7:00 a.m. to 10:00 p.m.)
$L_n = L_{eq}$ for the nighttime (10:00 p.m. to 7:00 a.m.)
24 indicates the 24 hour period
& denotes decibel addition

C. Community Noise Equivalent Level (CNEL)

The CNEL is a measure of the cumulative noise exposure over a 24 hour period. The CNEL index divides the 24 hour day into three subperiods, i.e., the daytime (7:00 a.m. to 7:00 p.m.), the evening (7:00 p.m. to 10:00 p.m.) and the nighttime (10:00 p.m. to 7:00 a.m.), and also applies weighting factors of 5 and 10 dBA to the evening and nighttime periods, respectively, to account for the greater sensitivity of people to noise during those periods. The CNEL values are calculated from the measured L_{eq} values in accordance with the following mathematical formula:

$$CNEL = [(L_d + 10 \log_{10} 12) \ \& \ (L_e + 5 + 10 \log_{10} 3) \ \& \ (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24$$

where:

$L_d = L_{eq}$ for the daytime (7:00 a.m. to 7:00 p.m.)
$L_e = L_{eq}$ for the evening (7:00 p.m. to 10:00 p.m.)
$L_n = L_{eq}$ for the nighttime (10:00 p.m. to 7:00 a.m.)
24 indicates the 24 hour period
& denotes decibel addition

D. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighting network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of a Gen Rad Company Community Noise Analyzer, which provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the analyzer was provided by a microphone extended to a height of 5 ft. above the ground. The "A" weighting network and the "Fast" response setting of the analyzer were used in conformance with the applicable standards. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

APPENDIX B-4

GEOTECHNICAL ANALYSIS

EARTH SYSTEMS CONSULTANTS

PALO ALTO, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

GEOTECHNICAL REPORT

PROPOSED SAN JOSE ARENA - SITE B

San Jose, California

Prepared for

DAVID J. POWERS & ASSOCIATES

San Jose, California

By

EARTH SYSTEMS CONSULTANTS
1900 Embarcadero Road
Palo Alto, California

JULY 1987

Earth Systems Consultants

GEOTECHNICAL ENGINEERING • ENGINEERING GEOLOGY • ENVIRONMENTAL GEOLOGY

File No. C6-2280-C1
July 20, 1987

Mr. David J. Powers
David J. Powers & Associates
1885 The Alameda, Suite 210
San Jose, California 95126

Subject: Proposed San Jose Arena - Site B
San Jose, California
GEOTECHNICAL REPORT

Gentlemen:

We are pleased to submit the enclosed report which presents the findings of our geotechnical study and evaluation of Site B. Site B is one of three sites in San Jose that is being considered as a possible location for the proposed multi-purpose civic arena.

Our report concludes that from a geotechnical point of view, this site is considered suitable for the proposed development. The geologic conditions that would impact upon the project are identified and evaluated in the report. The enclosed recommendations outline measures that could be implemented to mitigate those conditions that were identified as having a potentially adverse impact upon the development. The report also includes recommendations concerning which types of foundations would be suitable for an arena built on this site.

It was a pleasure to work with you on this most interesting project. If you have any further questions please do not hesitate to contact our office. This report completes our current assignment on this project.

Very truly yours,

EARTH SYSTEMS CONSULTANTS

Bruce O'Neill, Project Engineer

Reviewed by:

Murray Levish, C.E.G. 194

John P. Nielsen, C.E. 16113

BON/ML/JPN:tm

Copies: 2 to David J. Powers & Associates

1900 Embarcadero Road • Suite 200 • Palo Alto • California • 94303 • (415) 856•6750

CONTENTS PAGE NO.

CONTENTS - continued PAGE NO.

GEOTECHNICAL REPORT

SUBJECT: PROPOSED SAN JOSE ARENA - SITE B
SAN JOSE, CALIFORNIA

CLIENT: DAVID J. POWERS & ASSOCIATES

INTRODUCTION

There is a proposal that a 20,000 seat multi-purpose arena be built in San Jose. Three possible sites for the arena are currently being studied: Site A, Site B and Site C. This Geotechnical Report presents the results of our geotechnical evaluation of Site B. Site B is located adjacent to the Guadalupe River north of New Julian Street in central San Jose (see Figure 1, page 4). The site is bounded on the north by the Southern Pacific Railway tracks, on the east by the Route 87 Right-of-Way, and on the west by Autumn Street. The evaluations of Sites A and C are presented in separate reports.

Proposed Development

If the arena is built on Site B, it is currently proposed that it will be located at the northwest corner of Old West Julian and Pleasant Streets (see Figure 2, page 5). The Project Architect, Sink Combs Dethlefs, has indicated that the arena will be a predominantly concrete structure with metal framing supporting the roof and will be approximately 350 by 450 feet long. The heavy, unitized concourse portion of this structure is expected to be a relatively rigid body that will respond to movement as a unit, whereas the

metal framed roof is a relatively flexible structure. This combination of structural elements should produce a structure that is relatively insensitive to differential settlement of the supporting soil. It is anticipated that the arena will have a 15-foot-deep basement, and that the foundation loads will be concentrated near the perimeter of the building. Preliminary estimates made by the Project Structural Engineer indicate that each column will carry approximately 250 kips.

Surface parking will be provided around the arena and a parking structure will be constructed in the south-central portion of the site. It is anticipated that the parking structure will be constructed with reinforced concrete columns, beams, and shear walls and will be less tolerant of differential settlement than the arena. The final size of the parking structure has not been determined, however if the largest structure under consideration is built, the Project Structural Engineer estimates that the column loads will be approximately 1000 kips.

Purpose and Scope

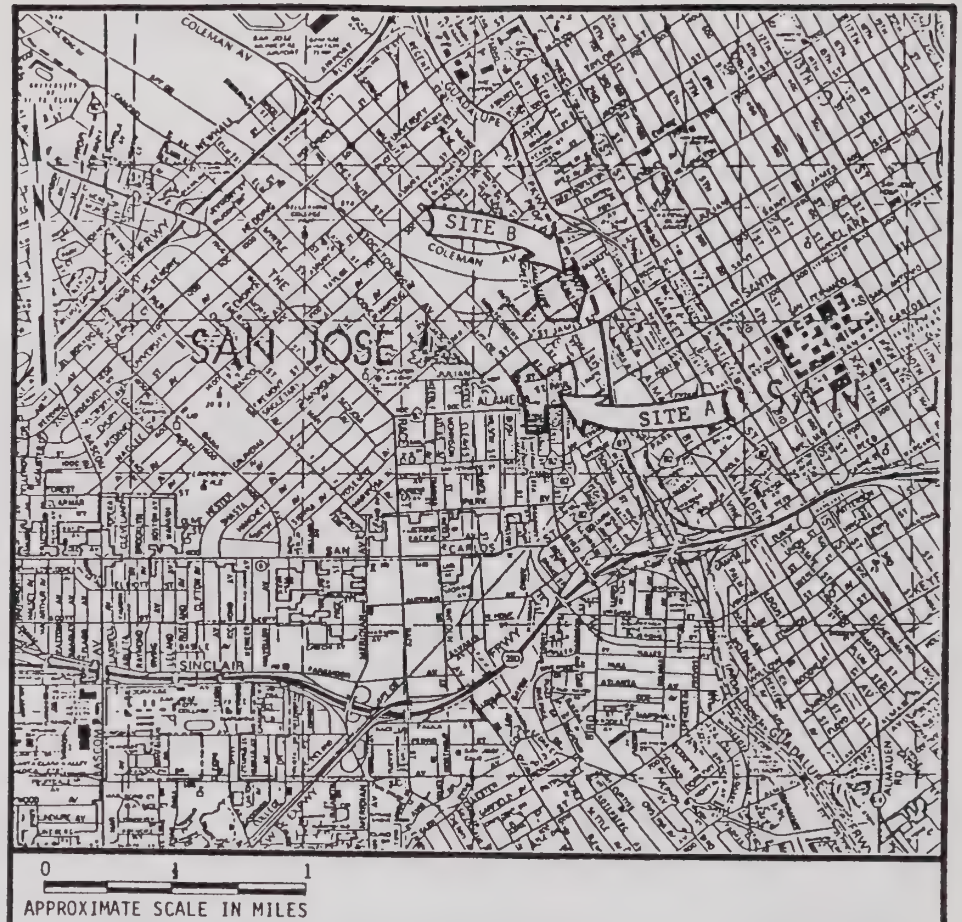
The purpose of this study was to evaluate the geologic and seismic conditions at this site; to evaluate the behavior of the soils under earthquake-induced vibrations and under the loading imposed by the proposed arena; and to discuss the suitability of the proposed site with regard to the construction of an arena facility.

This study included a review of pertinent geotechnical literature and maps; execution of five cone penetrometer probes; drilling and sampling from three exploratory borings; laboratory testing of some of the retrieved samples; analysis of the data obtained by these programs; and the preparation of this report.

Conclusions presented in this report are based on the data acquired and analyzed during this study. This report is intended to be an addendum to the Environmental Impact Report being prepared for this project and should be used for planning purposes only. Further detailed site investigation and data analysis will be required in order to develop specific foundation recommendations and soil design parameters.

Site Description

Site B is a relatively level parcel of land and is approximately 15 to 20 feet above the level of the Guadalupe River bed which runs through the site. The site is currently occupied by a FMC manufacturing plant and several small businesses. The entire site appears to have been developed at one time or another although there are some vacant lots on the site at present. The Guadalupe River banks are restrained where the river flows under the bridges that carries New Julian Street, Old Julian Street, and the Southern Pacific Railroad. The remainder of the river banks are unrestrained, and the channel is unlined. The banks are partially vegetated and exist at slopes that vary from approximately 1:1 to 2:1 (horizontal to vertical).



LOCATION MAP

Proposed San Jose Arena - Sites A and B
San Jose, California

Base: Thomas Bros. Map Book 40256

Figure 1

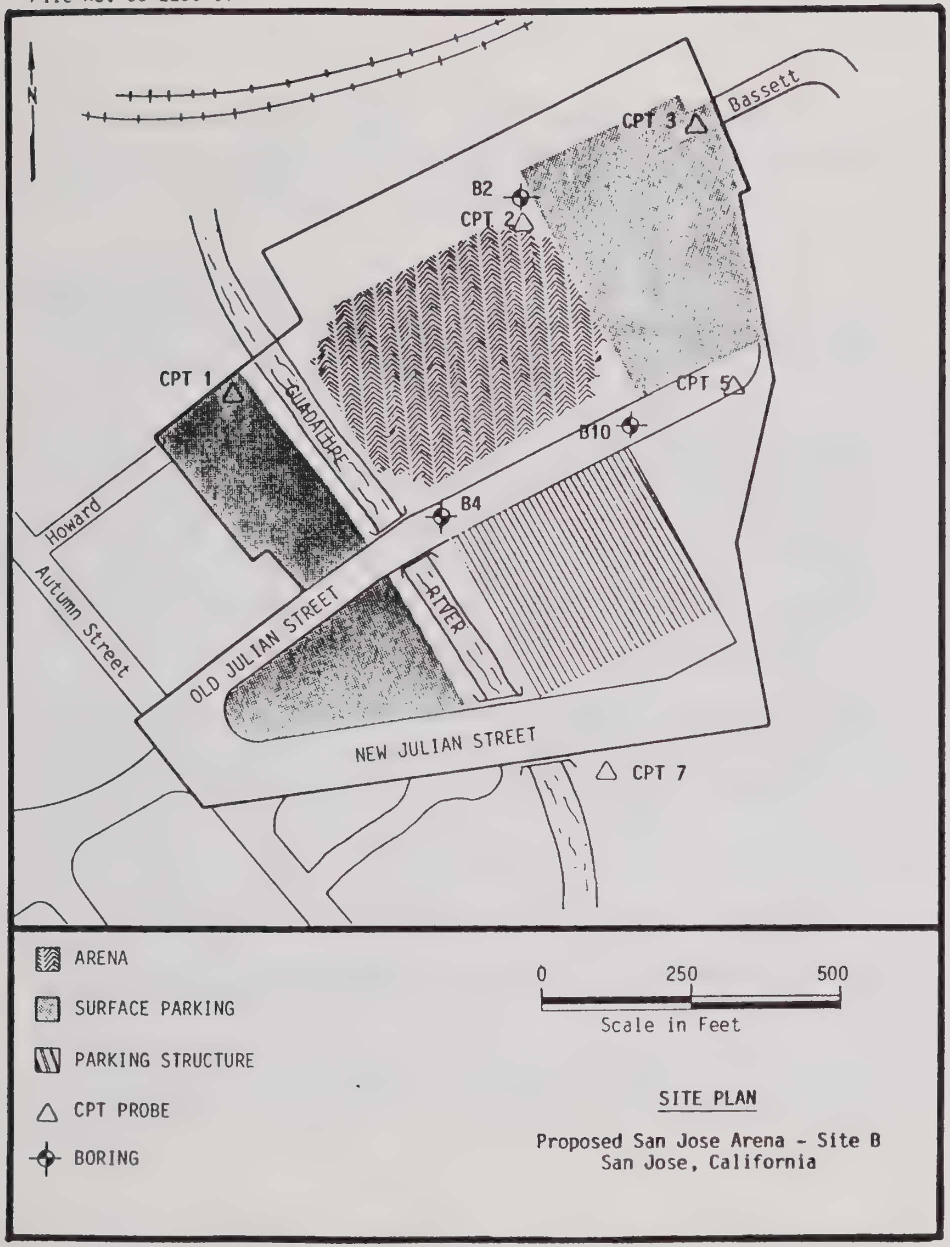


Figure 2

PROCEDURES AND RESULTS

Geologic Setting

Site B is located in the Santa Clara Valley, between the base of the western foothills of the Hamilton-Diablo Mountain Range and the northeastern foothills of the Santa Cruz Mountains in the Coast Range Geomorphic Province of Central California. Bedrock in this area is the Franciscan Complex, a diverse group of igneous, sedimentary and metamorphic rocks of Upper Jurassic to Cretaceous age (70 to 140 million years old). These rocks are part of a northwest-trending belt of material that lies along the east side of the San Andreas Fault system. Geologic cross sections of the area contained in California Department of Water Resources Bulletin No. 118-1 (1975) indicate that the depth to bedrock in this area is in excess of 600 feet.

The Franciscan rocks are overlain, in this area, by marine and non-marine sediments of Cretaceous to Plio-Pleistocene age (80 to 2 million years old), which are, in turn, covered with alluvial, fluvial, lacustrine and bay deposits of Pleistocene to Holocene age (less than 2 million years old).

The regional geology has been mapped by Davis and Jennings (1954), Nilsen (1972), Rogers and Williams (1974), and Helley and Brabb (1971). These maps differ in scale and detail, but they generally agree that the site is underlain at the surface by fine-grained non-marine sediments of undetermined depth. The latter two references describe the materials on the site as fluvial deposits from the edge of alluvial fans.

The U.S. Department of Agriculture (1968) has mapped one agricultural soil on this site, the Campbell silty clay loam. This soil has an effective depth of 60 inches, and a moderate shrink/swell potential.

Seismic Setting

None of the references studied show a fault on this site. Faults mapped in the site vicinity are shown on Figure 3 (page 8).

The closest fault to the site is the Silver Creek Fault, which has been mapped approximately 1.8 miles to the northeast (California Department of Water Resources, 1963). Davis and Jennings (1954) and Rogers and Williams (1974) show the Silver Creek Fault to end at the north end of Silver Creek Canyon, about 5 miles southeast of the site. This fault was first mapped by Crittenden (1951) and was described by him as a branch of the Calaveras.

Jennings (1975) shows the Silver Creek to be a "Quaternary" fault, or one that has displayed movement between 200 and 2,000,000 years ago. United Soil Engineering (1978) indicates that the youngest sediments affected by the Silver Creek Fault are 500,000 years old. The Silver Creek has been designated as a potentially active fault by Cooper-Clark and Associates (1974) and the Santa Clara County Planning Department (1975). Helley and Brabb (1971) show undisturbed Quaternary sediments in the valley across the projected trace of the Silver Creek Fault.

The Evergreen Fault has been mapped approximately 6 miles east of this site, near the base of the hills (Rogers and Williams, 1974; Dibblee, 1972). This

0 5
Scale in Miles

■ ARENA SITE

— ACTIVE FAULT

– – – POTENTIALLY ACTIVE FAULT

+ EARTHQUAKE EPICENTERS OF MAGNITUDE 0.5 OR GREATER (1969-1970)

REGIONAL FAULT MAP

Proposed San Jose Arena
Sites A, B and C
San Jose, California

Compiled from Brown & Lee, 1971; Rogers & Williams, 1974; and California Division of Mines and Geology, 1982

Figure 3

fault is shown by Jennings (1975) to be "Quaternary." Cooper-Clark and Associates (1974), Rogers and Williams (1974) and the Santa Clara County Planning Department (1975) show this fault to be potentially active.

In 1978, Berlogar, Long and Associates conducted a study of the Mirassou Winery property (located southeast of this site), during which they trenched across the mapped trace of the Evergreen Fault. No evidence of faulting was found along the trace mapped by Dibblee (1972) and Cooper-Clark (1974).

Approximately 900 feet east of Dibblee's trace, one of Berlogar, Long's trenches exposed geologic features that were interpreted by them as indicative of faulting. The "East Evergreen Fault" was zoned under the provisions of the Alquist-Priolo Special Studies Zones Act, based on those findings.

The Special Studies Zone originally established on the Evergreen Fault followed the traces mapped by Dibblee (1972), and has subsequently been removed from the most recent maps. Further exploration of that site by Earth Systems Consultants (1984) failed to produce any evidence of active faulting along either the Evergreen or East Evergreen faults.

The Crosley Fault has been mapped along the base of the hills, approximately 5.5 miles northeast of the site (Rogers and Williams, 1974; Dibblee, 1972). This fault has been classified as potentially active by Rogers and Williams (1974) and by the Santa Clara County Planning Department (1975). Jennings (1975) shows it to be a "Quaternary" Fault, or one that has moved between 200 and 2,000,000 years ago. This fault does not appear on the maps by Crittenden

(1951), Davis and Jennings (1954) nor Brown and Lee (1971). Dibblee (1973) was the first to map a continuous fault along the base of the hills in eastern San Jose. This exposure was surveyed and confirmed by Burkland and Associates during a study of the Minoli property, south of Crosley Creek (Burkland and Associates, 1977b).

Studies done along the Crosley Fault (Burkland and Associates, 1977a,b,c,d; 1978a,b,c; and Earth Systems Consultants, 1978, 1983, 1986) have shown it to be an active reverse fault with a variable dip to the east. Dibblee (1972) and others show the Crosley to be part of the Hayward Fault system.

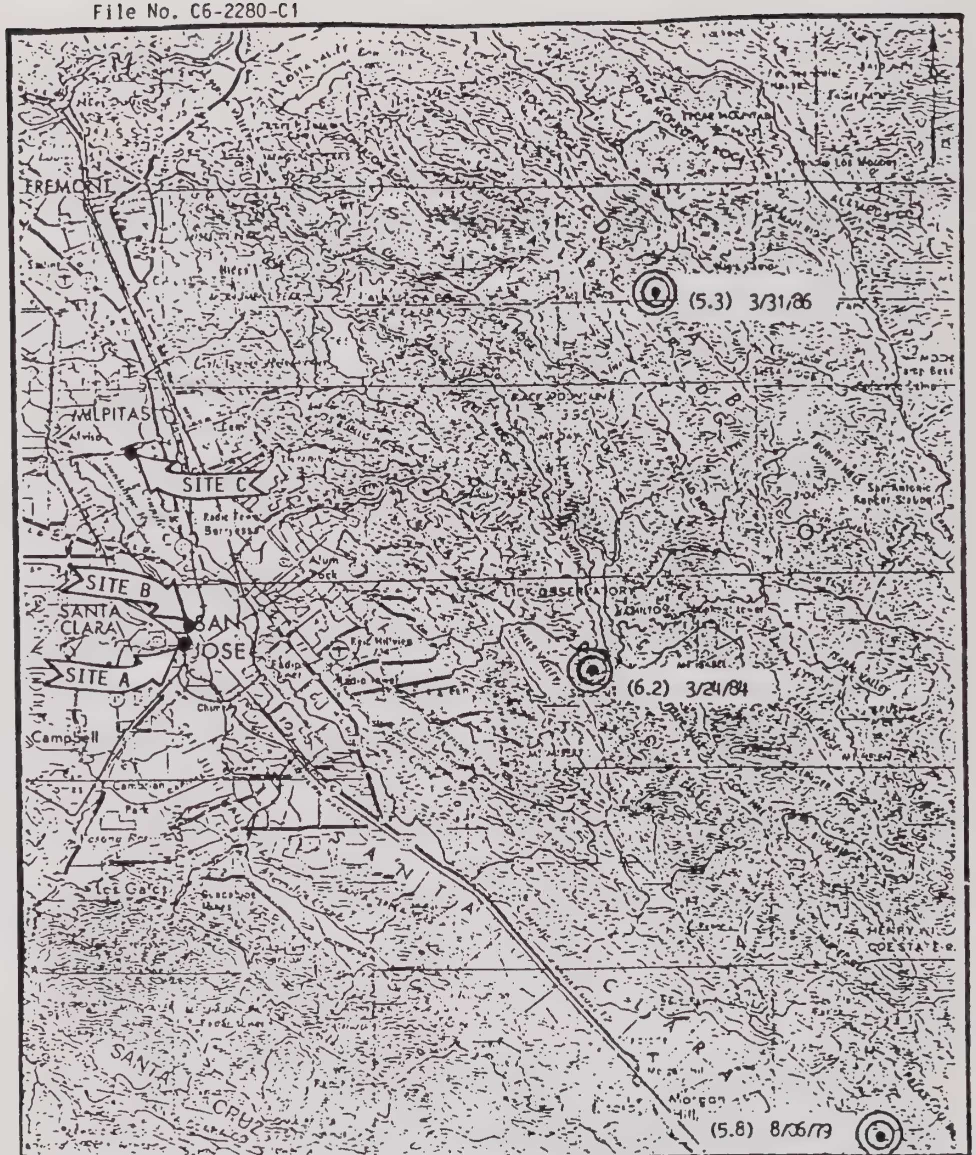
The active Hayward Fault has been mapped approximately 6.8 miles northeast of the site (Dibblee, 1972; Rogers and Williams, 1974; California Division of Mines and Geology, 1982). This fault is known to be creeping in Fremont. Ground rupture occurred along parts of the Hayward Fault from Warm Springs northward during the earthquakes of 1836 and 1868 (Radbruch-Hall, 1974).

The Sargent-Berrocal Fault has been mapped 7.3 miles southwest of the site. This section of the fault is considered to be potentially active.

The Calaveras Fault, 8.1 miles northeast of the site, and the Hayward Fault, are both part of the regional San Andreas Fault system. The main trace of the San Andreas is located about 11.5 miles southwest of the site, in the Santa Cruz Mountains. All three of these faults have been zoned by the California Division of Mines and Geology (1982).

A number of major earthquakes are known to have occurred in the vicinity of the site. The October 8, 1865 earthquake (estimated Richter magnitude 6.5) was centered on the San Andreas Fault, approximately 13 miles west of the site. The epicenter of the October 21, 1868 event (estimated Richter magnitude 7.0) has been located at a point approximately 14 miles northwest of the site on a branch of the Hayward Fault. The epicenter of the earthquake of April 18, 1906 (Richter magnitude 8.3), originally plotted in Olema, Marin County, has been relocated to a point in northern San Mateo County, approximately 38 miles northwest of the site (Real et al., 1978). The July 1, 1911 earthquake (estimated Richter magnitude 6.6) is plotted as having occurred approximately 8 miles southeast of the site. The location of that epicenter is uncertain and it has not been ascribed to movement on any particular fault. The 1979 Coyote Lake (Richter magnitude 5.8), and the 1984 Halls Valley (Richter magnitude 6.2) earthquakes were centered on the Calaveras fault approximately 27 and 12 miles east of the site. The 1986 earthquake near Mt. Lewis (Richter magnitude 5.3) was centered approximately 8 miles northeast of the site and was not ascribed to a known fault (see Figure 4, page 12).

The site has been classified by Rogers and Williams (1974) according to its seismic hazard potential. It is located within their zone D1-2, which includes areas in which the groundwater table is 10 to 20 feet below the surface, and where there is a high potential for seismically-induced liquefaction.



0 5
Scale in Miles

(5.3) Richter Magnitude

LOCATION OF RECENT NEARBY
MAJOR EARTHQUAKE EPICENTERS

Proposed San Jose Arena Sites A, B and C
San Jose, California

Figure 4

The map prepared for use in preparing the Santa Clara County Seismic Safety Plan (Seed, 1974) places this site in the category "Possible Liquefaction, Requires Investigation." This map indicates that the estimated characteristic period of the soil deposit is between 1.2 and 2.0 seconds.

The soil reports for four nearby projects were on file in the City of San Jose Public Works Department. In 1973, Woodward Lundgren prepared a report for the New Julian Street bridge; in 1981, Terratech prepared a report on a site at the northeast corner of West Julian and Guadalupe Parkway; in 1985, Donald Banta & Associates prepared a report for a site on the northwest corner of Julian and Autumn Streets; and in 1985, United Soil Engineering prepared a report for a site on the east side of Autumn Street at Howard.

Terratech's report stated that even during severe ground shaking, the weak layers of soil at this site would not collapse. United Soil Engineering found that there was a low to moderate potential for strength loss during an earthquake. They stated that the 10-to 12-foot thick layer of natural soil above the water table would help bridge over the weak layers. Banta's study concurred with this finding, saying that the overlying clayey soils would form a "cap" over the thin lenses of sand. Woodward-Lundgren did not address this issue.

In analyzing the available data in these reports, it appears that there may be a greater possibility for liquefaction and densification of the soils to occur during a seismic event than was expressed in the above reports. United Soils Engineering plotted data points from borings on a Liquefaction Potential Graph. Data from sample 1-4 at a depth of 16 feet lies on the moderate to

high liquefaction potential division line. The sand layer that this sample lies in appears to some degree in all of the United Soils Engineering's boring logs and in logs from Banta and Woodward-Lundgren. Banta's Boring No. EB-2 shows sand layers with less than 20 percent fines with blow counts of 45 blows per foot. This blow count indicates that the layer is probably dense enough that it would not liquefy. In Woodward-Lundgren's logs, the blow counts in this material are generally low but the fact that 365-pound and 265-pound hammers were used in obtaining most of the samples must be taken into consideration.

Subsurface Exploration

The subsurface exploration program at this site consisted of two phases; cone penetration testing and exploratory drilling. The locations of the probes and borings were distributed to cover the entire site with a concentration around the proposed location of the arena and the parking structure. The approximate locations of the probes and borings are shown on Figure 2. Access to the site during the subsurface exploration was restricted, and therefore, the field work was confined to the City streets. Note that the CPT and Boring numbers are indicative of a location and do not reflect the number of probes or borings placed during this study.

Cone Penetration Testing

An electronic cone penetrometer (CPT) was used to probe the site at four locations on May 19, 1987. The probes ranged in depth from 45 to 75 feet. Information derived from the cone probes included a continuous profile of site stratigraphy, and correlations with various soil strength parameters.

A CPT is a 1.4-inch diameter steel cone which is instrumented to record the bearing pressure on the tip of the cone (tip resistance), the friction along a 4-inch long segment of the probe (local friction), and the pore water pressure behind the tip of the cone. Plots of the tip resistance, the local friction, the friction ratio (local friction/tip resistance), the pore pressure and the differential pore pressure ratio (measured pore pressure minus hydrostatic water pressure all divided by tip resistance) are presented in Appendix A. The cone measures these values continuously and records a set of measurements every 2 inches. The cone is pushed into the ground with a hydraulic press which is mounted on a conventional drill rig truck.

Based on empirical correlations, the parameters measured by the cone penetrometer can be used to infer the soil type, the relative density of the soil, the angle of internal friction, the equivalent N value (standard penetration test blow count), the cyclic stress ratio, and the undrained shear strength of the soil. The validity of these empirical correlations is enhanced if they are confirmed with local experience. For that reason, an exploratory boring was placed adjacent to CPT Probe 2. The interpretation of these parameters, based on the empirical correlations, has been computerized. Due to the volume of output accumulated, the processed data is not enclosed in this report. The data is stored in the files of Earth Systems Consultants, and is available upon request. Included with the other plots of the cone data are interpreted plots showing the generalized stratigraphy, and some of the relevant soil properties as derived from the empirical correlations.

Drilling and Sampling

The second phase of the subsurface exploration program consisted of the drilling and sampling of three test borings on May 27, 1987. One boring was placed adjacent to the location of CPT Probe 2 to aid in developing on-site correlations between the CPT data, the visual classification of the material, and the soil parameters measured in the laboratory. The other borings were distributed across the site to aid in developing a more detailed site profile. The borings were drilled with a truck-mounted drill rig equipped with 8-inch diameter, hollow stem, continuous flight augers. Borings were drilled to a depth of 40 feet below the existing ground surface. According to the Santa Clara Valley Water District regulations exploratory borings placed deeper than 50 feet require special measures to seal the boreholes to prevent possible cross contamination of water aquifers. In the site selection phase of the geotechnical evaluation we were requested by Mr. David J. Powers to not complicate the field investigation in that manner, thus the borings were restricted to a depth of 45 feet during this phase of the investigation.

Each boring was visually logged in the field by a field engineer. Relatively undisturbed samples were obtained by using a 3-inch O.D. Modified California Sampler lined with 2½-inch O.D. by 6-inch-long brass tubes. The sampler was driven 18 inches into the soil using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final 12 inches are recorded on the boring logs, which are presented in Appendix A. Pocket penetrometer tests were run to develop an initial estimate of the variation of shear strength with depth. The

stratification lines on the boring logs represent approximate boundaries between soil types, but the actual transitions may be gradational.

Laboratory Testing

The laboratory testing program was directed toward determining some of the physical and engineering properties of the soils on the site and developing local correlations with the CPT output. The results of the laboratory tests are presented in Appendix B.

Strength parameters of selected samples were determined by means of direct shear tests run on "undisturbed" samples. The samples were soaked for 24 hours prior to shearing. The direct shear tests were run at a constant rate of strain on unconsolidated samples that were free to drain. Strength parameters of selected samples of the cohesive soils were determined by means of unconfined compression tests.

A consolidation test was run on a representative clay sample to determine the compressibility of the material. Sieve analyses and hydrometer analyses were performed on selected samples of the granular material to determine the grain size distribution. Moisture/density tests were run on those samples not otherwise selected for testing.

Soils and Subsurface Materials

There are six major material types that were identified during the field investigation. However, the soil profile underlying this site is highly

variable. Some of the material types are not present in some locations, and those present vary in thickness and location below the ground surface.

Unit 1: The uppermost unit in Boring 10 was utility trench backfill. It was 11 feet deep and consisted of silty clays, and fine sand. The fact that this location was over a utility trench accounts for Unit 2 and 3 materials not being encountered at this location.

Unit 2: The near-surface material in Boring 2 is a dark grey brown, highly plastic clay. This layer was 6 feet thick at this location and was also found between 10 and 12 feet deep at this location. This material was located at a depth of 6 to 11 feet in Boring 4 and was not present in Boring 10.

Unit 3: Interbedded between the two layers of Unit 2 material in Boring 2 is a layer of Unit 3 material, grey-green silty clay. This material was 4 feet thick in Boring 2, and 3 feet thick in Boring 4 where it was located on top of the Unit 2 material, and was not found in Boring 10. This unit is softer and less plastic than the Unit 2 materials. Unit 3 varies in thickness from 3 to 6 feet.

Unit 4: Beneath the clay units is a layer of granular material. This layer consists predominantly of tan silty sands with varying amounts of fine grained material and fine gravel. This material ranges from medium dense to dense. In Boring 1 it was located between 12 and 14 and 17 to 27 feet. In Boring 2, it was located between 12 to 15 feet and 21 to 26 feet; and in Boring 10 it was located between 11 and 26 feet. The CPT Probes

identified layers of this material between depths of between 13 and 59 feet. The thickest layer was 20 feet thick (CPT 1).

Unit 5: This unit consists of dense sandy gravels. This unit was identified in Boring 2 between 14 and 17 feet, in Boring 4 between 15 and 21 feet, in CPT Probes 1, 3 and 5 between 40 and 46 feet, and in CPT Probes 1 and 2 below 64 feet. It was not encountered in Boring 10.

Unit 6: This unit consists of a predominantly silty clay with some sandy clay. This material varies in consistency from medium stiff to very stiff. In the borings, this material was observed to have a relatively uniform thickness of 12 to 14 feet. The CPT Probes indicate that this material has a relatively uniform thickness across the site extending from a depth of approximately 25 to 62 feet. In some locations there is a 6-foot thick layer of interbedded gravels between 40 and 46 feet.

Groundwater

The groundwater level was determined during the field exploration program to vary from between 12 to 37 feet below the ground surface. The groundwater level was visible in three of the borings and was determined during two of the CPT probes by pausing and allowing the excess pore pressures generated by the probe to dissipate.

Boring / CPT Probe	Depth Below Ground Surface
Boring 2	12-15 feet
Boring 4	15-18 feet
Boring 10	16 feet
CPT Probe 1	Not determined
CPT Probe 2	37
CPT Probe 3	Not determined
CPT Probe 5	33½ feet
CPT Probe 7	Not determined

The measurements with the cone were determined by measuring the equilibrium pore pressure at depth and calculating the corresponding groundwater level. The cone measurements appear to have discerned the level of the regional groundwater table. The borings encountered what appears to be a perched groundwater table at between 12 and 18 feet. The thickness of the perched groundwater table was not determined. The observed groundwater levels indicate that if the arena is to be constructed with a 15-foot-deep basement, some dewatering will probably be required during construction. Note that these measurements were taken in late May, 1987. The perched groundwater is a factor that has to be considered when designing the basement. The rainfall during the previous winter was below average, and the groundwater level during or after construction may be higher.

Response of the Soils to Seismic Loading

Some of the soils at this site may liquefy when subjected to seismic loading. Liquefaction is a phenomenon that occurs when loose, granular soils are subjected to strong ground shaking. Under these conditions, the granular soils will attempt to densify, resulting in the development of excess pore pressures which impedes densification. If the pore pressures cannot dissipate as rapidly as they are generated, the soil may then behave like a heavy, viscous fluid. Under these conditions, the soil will loose shear strength, and if the imposed shear stresses (due to structural loading, or the presence of a nearby slope) exceed the soil strength, the "liquified" soil will "flow." This can cause slope or foundation failures. Where the soil is confined or there are no imposed shear stresses, no movement occurs except for some possible areal or local settlement.

If the soils are only partially saturated, there is no impedance to densification, and as a result local and/or areal settlement occurs.

The susceptibility of the soils to liquefy depends on the degree of shaking to which they are subjected, the density of the soils, the amount of fine grained material in the soil, the confining pressure (the depth below the ground surface), and the degree of saturation.

The potential ground shaking at this site was estimated using the methods suggested by Seed and Idriss (1982). The site is located 6.8 miles from the Hayward Fault (maximum probable earthquake M = 7.0), and 11.5 miles from the San Andreas Fault (maximum probable earthquake M = 8.3). It is estimated that the maximum probable earthquake on the Hayward Fault would cause 10 to 15 cycles of significant shear stress at this site, with a maximum ground acceleration of 0.28g. Significant shear stress is defined as two-thirds the maximum shear stress developed during the earthquake. It is estimated that the maximum probable earthquake on the San Andreas Fault would cause 20 to 25 cycles of significant stress with a maximum ground acceleration of 0.24g.

A perched groundwater table was observed across parts of this site at a depth that ranged from 12 to 18 feet below the current ground level, but this groundwater was not encountered in other parts of the site. The regional groundwater level was measured with the CPT to be approximately 33 to 37 feet below ground level. The degree of saturation of the material between these two levels is unknown. This is important because saturated soils are more prone to liquefy than partially saturated materials. However, partially saturated soils are more prone to densify under cyclic loading.

Cyclic shear stress ratios (shear stress/confining pressure) are an indication of the susceptibility of a soil to liquefy. When the potential cyclic shear stresses that could be generated by the maximum probable earthquake exceed the level of cyclic stress that would cause the soil to liquefy, a potential problem exists. Our estimate of the cyclic stress ratios required to cause the soil to liquefy were derived from correlations with the CPT data and are based on work by Robertson and Campanella (1986).

Liquefaction is primarily confined to granular soils with a clay content of less than 15 percent. Sieve analyses and hydrometer analyses of several of the materials suspected of being susceptible to liquefaction were performed in the laboratory to determine their grain size distribution. The results of these tests which are presented in Appendix B confirmed the field classification of the material and indicated that they have an insufficient percentage of fine grained material to provide internal cohesion and prevent liquefaction.

The potentially liquefiable materials at this site appear to be wide spread, but lenticular, and not continuous over the entire site. A loss of shear strength in these materials during an earthquake could lead to lateral spreading and landsliding along the river bank. Densification of the loose to medium dense granular material could cause local or areal settlement especially in the partially saturated soils.

The loss of shear strength should not result in a loss of bearing capacity because the potentially liquefiable soils will be well confined. This could however be a problem near the river and in the area of depressed loading zones.

Response of the Site Soils to Loads Imposed by the Structures

Compressibility

If the arena is supported on a shallow foundation the primary response of the site soils to the loads imposed by the arena will be to compress and cause settlement. The compressible soils that will have the most impact on this project are the Unit 6 materials which begin at a depth of 25 feet (7 to 8 feet below the anticipated depth of shallow foundations). This material is highly compressible, and significant settlements will occur if the building is founded on shallow foundations. The difference in the thickness of compressible soils due to the presence of interbedded gravels will cause different amounts of settlement in various portions of the arena.

Initial estimates of the settlement and differential settlement that would occur indicate that they would be within tolerable limits for this type of structure provided that the foundation acted as a unit.

Materials Able to Support Deep Foundations

CPT Probes 1 and 2 indicate that there is a dense layer of granular material (Unit 5) underlying this site at a depth of between 63 and 65 feet below the existing ground surface. The capacity of the CPT was reached on each of these holes, so the thickness of this layer was not determined. This layer of material would probably provide excellent support for deep end-bearing piles. CPT Probes 1, 3 and 5 indicate that there are intermittent shallower layers of this material on the site. The shallower layers could be a serious impediment to driving piles down to the lower

granular material. In some areas, the shallower layers may be capable of supporting end bearing piles.

Suitable Foundation Types

Suitable foundation types for the major and minor structures on this site are discussed below. Suitable foundations must be able to sustain seismic loading, settlement due to consolidation of the underlying soils, possible areal settlement of the underlying soils during an earthquake, and the loads imposed by the proposed arena. In order to provide soil design parameters, additional site investigation work will be required.

I. Spread Foundations

The arena and the parking structure are both in areas that could be affected by lateral spreading or slumping along the river bank during a seismic event. If spread foundations are to be used at this site, one of several options needs to occur.

1) The structures could be relocated, farther from the river bank.

2) A cutoff wall or other structure could be constructed to isolate the soils under the arena from the river banks.

3) The potentially liquefiable soils under the arena could be densified by dynamic compaction or compaction grouting after the initial excavation had been completed.

4) The potentially liquefiable soils could be over excavated and replaced with engineered fill.

The following discussion of spread footings assumes one of these courses of action has been taken. The alternative is to found the structures on deep foundations.

a. Conventional Spread Footings

Conventional spread footings may be suitable for this project if the concourse portion of the structure is sufficiently rigid that the footings will act as a unit and not independently. The differential settlement of the foundations and the possible dynamic consolidation of the granular deposits during an earthquake and the consolidation of the underlying Unit 6 material due to the loads imposed by the structure will probably exceed tolerable limits for independent footings. Unitized, conventional spread footings may be suitable for minor one- or two-story light weight structures such as ticket sales offices, etc.

b. Mat Foundation

If conventional spread footings can not be adequately tied together, a unitized mat foundation may be a suitable foundation for the arena on this site. The prime advantage of this system is that the structure would respond as a unit to differential settlement of the underlying soils and could span any localized soft areas.

c. Compensated Foundation

The bearing capacity of the foundation could be increased, and the amount of post-construction settlement decreased if a compensated foundation was constructed rather than a mat foundation. A compensated foundation is

similar in form to a mat foundation, except that the depth of the foundation is increased. A fully compensated foundation is one where the weight of the structure matches the weight of the soil that is excavated from the site. The depth of a compensated foundation may be restricted by the groundwater level, because of the need to dewater. The dewatering would be limited to the perched groundwater.

II. Deep Foundations

a. Piles

Driven piles could be used to construct suitable foundations for the structures on this site. The piles could be designed to develop bearing capacity with skin friction or by end-bearing on the dense sands and gravels found below this site. Dense intermediate level soil layers that may increase the difficulty of driving piles to the bearing layer were encountered in some locations. It may be possible to pre-drill holes through these layers, and then drive piles in these holes down to the bearing stratum.

b. Drilled Piers

If drilled piers are used at this site, it is expected that the pier holes will need to be cased to prevent collapsing, and that drilling mud may be required to prevent the saturated silty sands from flowing into the bottom of the pier hole. Unless specific structures or installations, that are susceptible to vibrations caused by pile driving, are identified in the vicinity of the arena and parking garage, drilled piers appear to be a less suitable foundation than driven piles.

CONCLUSIONS

The conclusions contained herein are based on the data acquired and analyzed during this study.

General

1. From a geotechnical viewpoint, this site is considered suitable for the proposed development, provided measures are implemented during design and construction of the proposed project, to mitigate the geologic and seismic hazards identified in this report.

2. The principle geologic hazards at this site are related to the presence of perched groundwater, relatively unconsolidated granular materials, and compressible soils; and steep unrestrained banks along the Guadalupe River. Seismic hazards include ground shaking and consequent secondary ground failure.

3. A moderate to major earthquake on the Hayward, Calaveras, San Andreas, or one of the other active faults in the Bay Area could produce severe ground shaking at this site.

4. There is no evidence that an active or potentially active fault crosses this site. The potential for ground rupture to occur is therefore considered to be low.

5. There are several layers of potentially liquefiable materials underlying this site. The potential for seismically-induced liquefaction to occur is considered to be moderate to high in those materials. The most

significant layer of this material is located at a depth of 12 to 26 feet below the existing ground surface. This material will be prone to a loss of shear strength and bearing capacity during an earthquake. The selection of a suitable foundation for the proposed structures at this site will be significantly affected by this layer of material.

6. Seismic loading of the potentially liquefiable soils could cause local and areal settlement.

7. The potentials for seismically-induced lateral spreading and landsliding to occur is considered to be high along the unrestrained portions of the river banks. The arena and the parking structure are both located in an area that would be affected should this occur.

8. Normal erosion along the Guadalupe River will result in the downcutting and gradual widening of the channel, where it is not confined or controlled. Local slumping along the banks is a normal part of this erosion. Loads imposed by structures built near the top of the bank could accelerate this process.

9. The regional groundwater table at this site is located approximately 33 to 37 feet below the existing ground surface. A perched water table is located 12 to 18 feet below the ground surface. The level of both of these groundwater tables will probably vary according to the seasonal rainfall. Records of the regional groundwater level indicate that the groundwater level has been higher than currently observed, and was lowered by pumping. The

groundwater level has increased recently due to a decline in pumping but could be lowered again if pumping was to increase, or raised if pumping was to cease. Excavations at this site that extend below the perched water table level will require dewatering.

10. The question of whether the soil at this site is contaminated was to be studied by others. It was not within the authorized scope of work on this project and was not addressed by this study.

11. The suitability of this site for this project relative to the other two sites can be determined by a comparison of the hazards present at each site (see Table I, page 31).

Environmental Impact

12. The construction of an arena at this site would require that the existing buildings be demolished, that significant site grading be done, and that many of the existing utilities be relocated. It should be expected that this time of activity will generate a significant amount of noise at this site, and that construction traffic will generate noise on the access streets to this project as well.

13. Construction traffic also poses a potential risk to other vehicles using the streets, will impose significant loads on access streets shortening their life span and necessitating repairs of some of them, and will tend to spread soil into the city streets.

14. Site work will generate dust during the dry summer months. If the construction of this project extends through a winter, the surface runoff water will contain an increased sediment load.

15. The amount of, and impact of noise, traffic, dust, and sediment generated by this project can be minimized by careful planning and construction management.

16. Extensive grading or increased gravity loading along the unsupported river bank on the east edge of the site could cause failure of that slope. Neither of these activities are included as part of the current site development plan.

17. Paving or construction of buildings over most of the site will limit the ability of precipitation to aid in recharging the groundwater supply. It will also limit access for the purpose of pumping groundwater.

TABLE I

COMPARISON OF THE GEOTECHNICAL CONDITIONS THAT WOULD IMPACT THE PROPOSED ARENA, BY SITE

	SITE A	SITE B	SITE C
SITE SUITABLE FOR PROPOSED DEVELOPMENT	YES	YES	YES
SITE SUBJECT TO STRONG GROUND SHAKING	YES	YES	YES
POTENTIAL FOR GROUND RUPTURE TO OCCUR AT THIS SITE	LOW	LOW	LOW
POTENTIALLY LIQUEFIABLE SOILS IDENTIFIED ON THE SITE	YES	YES	YES
POTENTIALLY LIQUEFIABLE SOILS SHOULD BE ADDRESSED DURING DESIGN	NOT REQUIRED	YES	YES
LATERAL SPREADING AND/OR SLUMPING MAY OCCUR ALONG THE STREAM BANKS THAT COULD AFFECT THE ARENA	NO	YES	NO
POTENTIAL FOR LURCH CRACKING TO OCCUR AT THIS SITE	LOW	LOW	LOW TO MODERATE
REGIONAL GROUNDWATER MEASURED WITHIN 20 FEET OF THE GROUND SURFACE	NO	NO	YES
PERCHED GROUNDWATER MEASURED WITHIN 20 FEET OF THE GROUND SURFACE	YES	YES	NO
COMPRESSIBLE SOILS IDENTIFIED WITHIN THE ZONE OF INFLUENCE OF THE ARENA FOUNDATIONS	YES	YES	YES

RECOMMENDATIONS

General

1. The level of groundwater indicates that if the arena is to be constructed with a 15-foot-deep basement, some dewatering may be required during construction. It will be necessary to install a system that will permanently lower the level of the perched groundwater below the basement; to construct a watertight basement; or to install a system of drains and pumps that will handle water that seeps into the basement. If a watertight structure is built, it should be verified that the structural loads exceed the buoyancy forces acting on the structure when the perched groundwater is at its maximum possible level.

2. Potentially liquefiable soils were identified adjacent to the Guadalupe River at approximately the same elevation as the toe of the stream banks. The loss of shear strength in these materials during an earthquake due to liquefaction could cause slope failures. If facilities are to be constructed in this area, it is recommended that they be set back from the top of the bank or that an engineering solution be applied to stabilize the river bank.

3. Some of the loose, granular soils at this site may be expected to densify when subjected to strong ground shaking. This will result in local or areal settlement of the site. Near the river, where there is an open exposed face, some of the saturated granular soils may "flow" out of the slope, causing larger settlements near the river. Structures may be built near the river bank if measures are implemented to stabilize the banks, otherwise, structures should be set back from the top of the bank.

Further Investigation

4. The recommendations in this report regarding site suitability and suitable alternative foundation types are based on the limited site investigation that was described in the body of this report. It is our opinion that this study was comprehensive enough to identify any adverse geotechnical conditions at the site and to determine which types of foundations would be suitable at this site. Should this site be selected for development, further site investigation will be required in order to provide specific foundation design recommendations.

5. Access to the entire site should be arranged prior to the next stage of site investigation.

6. The structural engineer should be consulted to determine if the characteristic period of the site soils needs to be determined, and if a dynamic analysis of the site soils would be warranted.

7. The next phase of this investigation should include a detailed estimate of the expected settlement of the arena. This estimate will require a preliminary layout of the arena columns, and an estimate of their loads. This settlement estimate can be used to determine if a shallow foundation may be an acceptable foundation for the arena.

8. The next phase of this investigation should include a determination of the extent and thickness of the dense sands and gravels underlying this site, to aid in determining whether deep foundations would be suitable for this site.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The conclusions and recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed by the CPT probes or in the exploratory borings. If the actual construction will differ from that planned at the present time, Earth Systems Consultants should be notified to determine whether the conclusions and recommendations enclosed in this report are applicable to the revised project.

2. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes outside of our control. Therefore this report is subject to review by Earth Systems Consultants after a period of three (3) years has elapsed from date of issuance of this report.

3. This report was prepared upon your request for our services, and in accordance with currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

BIBLIOGRAPHY

1. Banta & Associates, 1986, FOUNDATION INVESTIGATION, HOUSING AUTHORITY OFFICE, JULIAN STREET.

2. Berlogar, Long & Associates, 1978, FAULT INVESTIGATION, MIRASSOU PHASE I, EVERGREEN AREA, SAN JOSE, CALIFORNIA.

3. California Department of Water Resources, 1963, EVALUATION OF GROUND WATER RESOURCES, SOUTH BAY, California Department of Water Resources Bulletin 118-1, Appendix A.

4. California Division of Mines and Geology, 1982, SPECIAL STUDIES ZONES, CALAVERAS RESERVOIR AND SAN JOSE EAST QUADRANGLES.

5. Cooper-Clark and Associates, 1974, GEOTECHNICAL INVESTIGATION, CITY OF SAN JOSE, SPHERE OF INFLUENCE, SAN JOSE, CALIFORNIA.

6. Crittenden, M. D., Jr., 1951, GEOLOGY OF THE SAN JOSE-MOUNT HAMILTON AREA, CALIFORNIA, California Division of Mines and Geology Bulletin 157.

7. Davis, F. F., and C. W. Jennings, 1954, MINES AND MINERAL RESOURCES OF SANTA CLARA COUNTY, CALIFORNIA, California Journal of Mines and Geology, Volume 50, No. 2.

8. Dibblee, T. W., Jr., 1972, PRELIMINARY GEOLOGIC MAP OF THE SAN JOSE EAST QUADRANGLE, U.S. Geologic Survey Open File Report.

9. Earth Systems Consultants, 1984, GEOLOGIC STUDY, MIRASSOU WINERY PROPERTY, SAN JOSE, CALIFORNIA.

10. Helley, E. J., and E. E. Brabb, 1971, GEOLOGIC MAP OF LATE CENOZOIC DEPOSITS, SANTA CLARA COUNTY, CALIFORNIA, U. S. Geological Survey Basic Data Contribution 27.

11. Jennings, C. W., 1975, FAULT MAP OF CALIFORNIA, California Division of Mines and Geology, Geologic Data Map Series, Map 1.

12. Nilsen, T. H., 1972, PRELIMINARY PHOTO INTERPRETATION MAP OF LANDSLIDES AND OTHER SURFICIAL DEPOSITS, ALAMEDA AND SANTA CLARA COUNTIES, CALIFORNIA, U. S. Geological Survey Basic Data Contribution 40.

13. Radbruch-Hall, D. H., 1974, MAP SHOWING RECENTLY ACTIVE BREAKS ALONG THE HAYWARD FAULT ZONE AND THE SOUTHERN PART OF THE CALAVERAS FAULT ZONE, U.S. Geological Survey Miscellaneous Investigation Map I-813.

14. Real, C. R., et al., 1978, EARTHQUAKE EPICENTER MAP OF CALIFORNIA, California Division of Mines and Geology, Map Sheet 39.

BIBLIOGRAPHY

15. Robertson, P. K., and R. G. Campanella, 1986, GUIDELINES FOR USE AND INTERPRETATION OF THE ELECTRONIC CONE PENETRATION TEST, Hogentogler and Company, Gaithersburg, Maryland, 196 pp.

16. Rogers, T. H., and J. W. Williams, 1974, POTENTIAL SEISMIC HAZARDS IN SANTA CLARA COUNTY, CALIFORNIA, California Division of Mines and Geology Special Report 107.

17. San Jose, City of, 1983, FAULT HAZARD MAPS.

18. Santa Clara County Planning Department, 1975, SEISMIC SAFETY PLAN.

19. Seed, H. B., 1974, UNPUBLISHED MAP PREPARED FOR THE SANTA CLARA COUNTY SEISMIC SAFETY ELEMENT - H. B. Seed Data, October 29, 1974.

20. Seed, H. B., and I. M. Idriss, 1982, GROUND MOTIONS AND SOIL LIQUEFACTION DURING EARTHQUAKES, Earthquake Engineering Research Institute, Berkeley, California, 134 pp.

21. Terratech, 1981, GEOTECHNICAL INVESTIGATION, DAVIDSON OFFICE BUILDING.

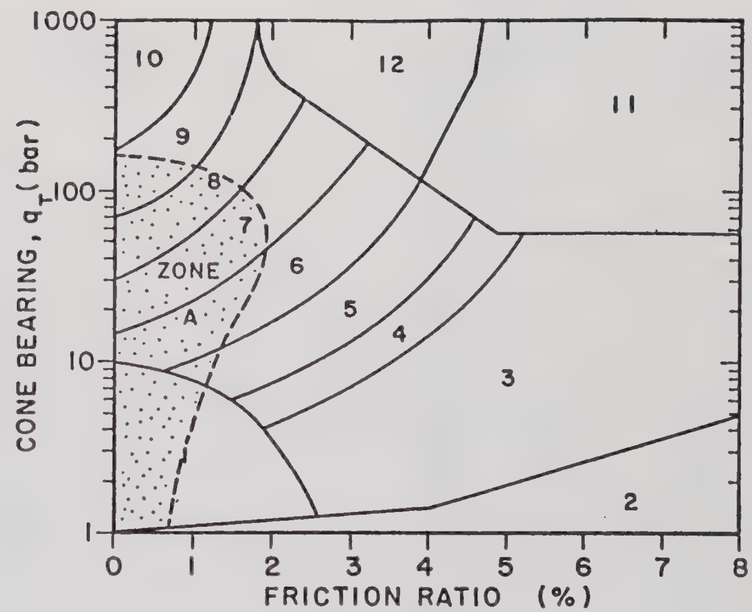
22. United Soil Engineering, 1978, GEOLOGICAL REVIEW OF THE SILVER CREEK FAULT TRACE FOR PROPOSED INDUSTRIAL DEVELOPMENT - FUTURE CHARCOT AVENUE.

23. United Soil Engineers, 1985, PRELIMINARY SOIL AND FOUNDATION INVESTIGATION, PROPOSED INDUSTRIAL SITE - HOWARD STREET & AUTUMN STREET.

24. U. S. Department of Agriculture, 1968, SOILS OF SANTA CLARA COUNTY, CALIFORNIA, Soil Conservation Service Publication.

25. Woodward - Lundgren & Associates, 1973, SOIL INVESTIGATION FOR PROPOSED JULIAN STREET - GUADALUPE RIVER BRIDGE.

APPENDIX A



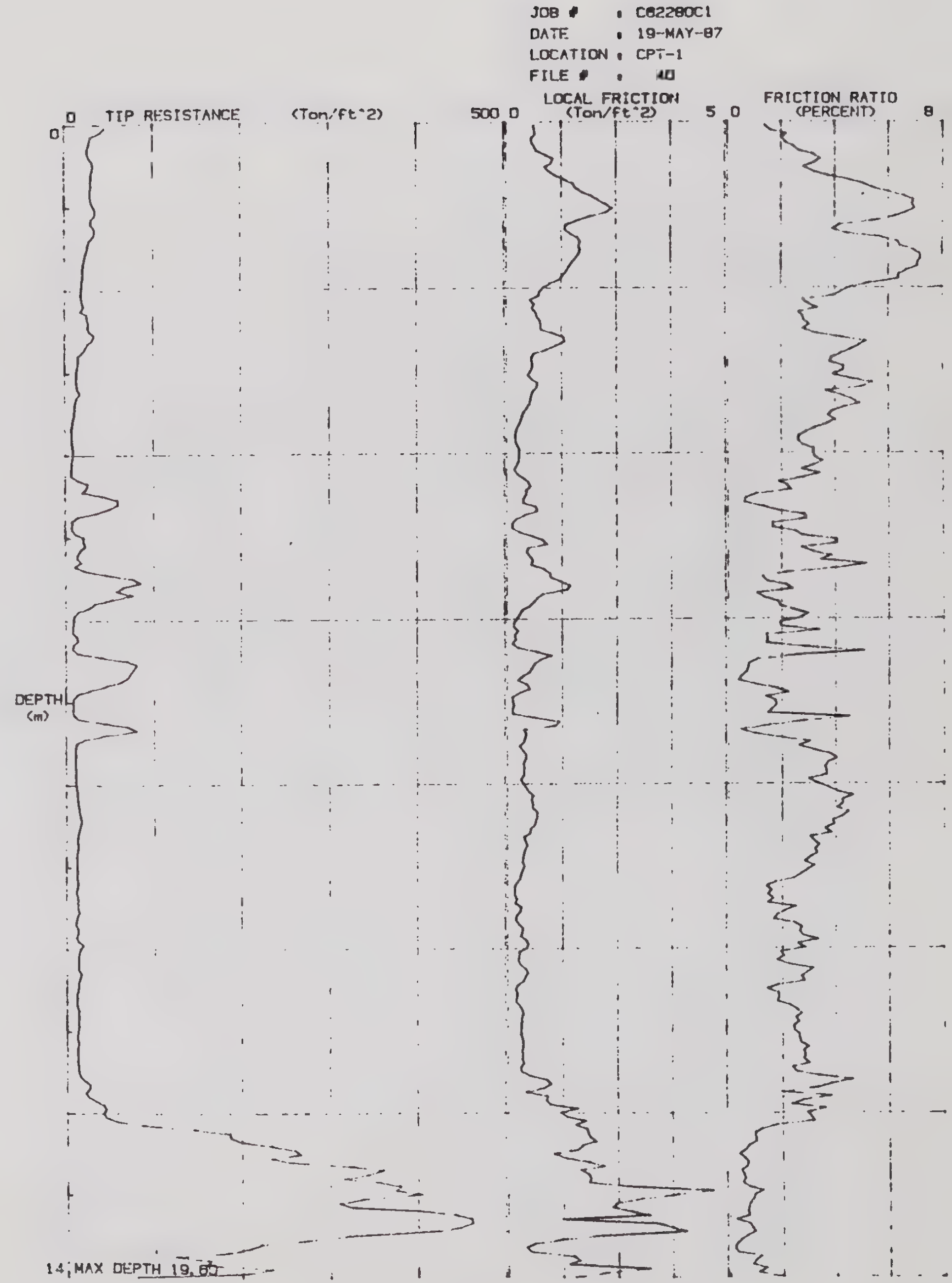
Zone	Soil Behaviour Type
1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained*
12	sand to clayey sand*

* overconsolidated or cemented.

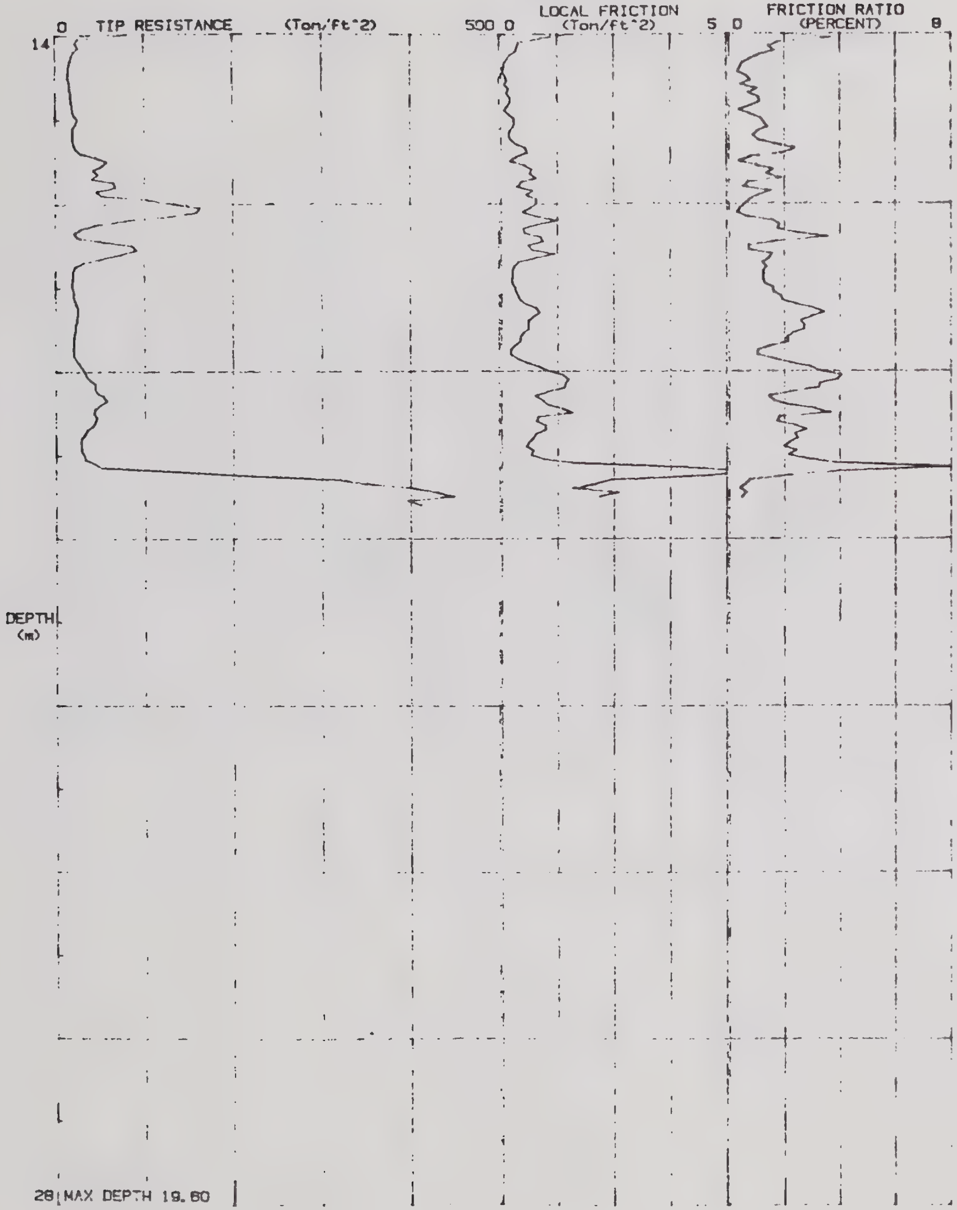
Materials within Zone A are potentially liquefiable.

SOIL CLASSIFICATION CHART

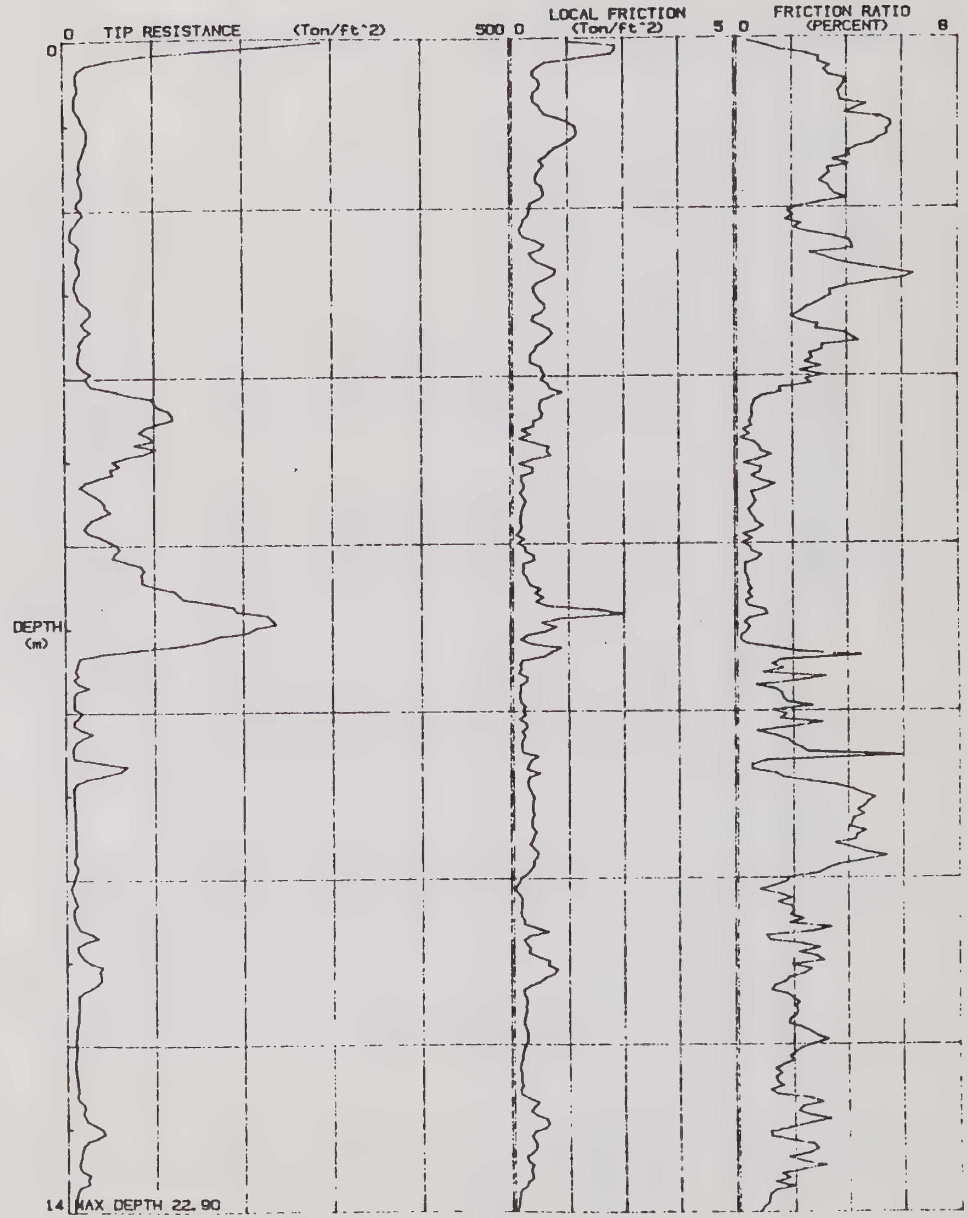
CPT Data: Tip Resistance, Local Friction and Friction Ratio

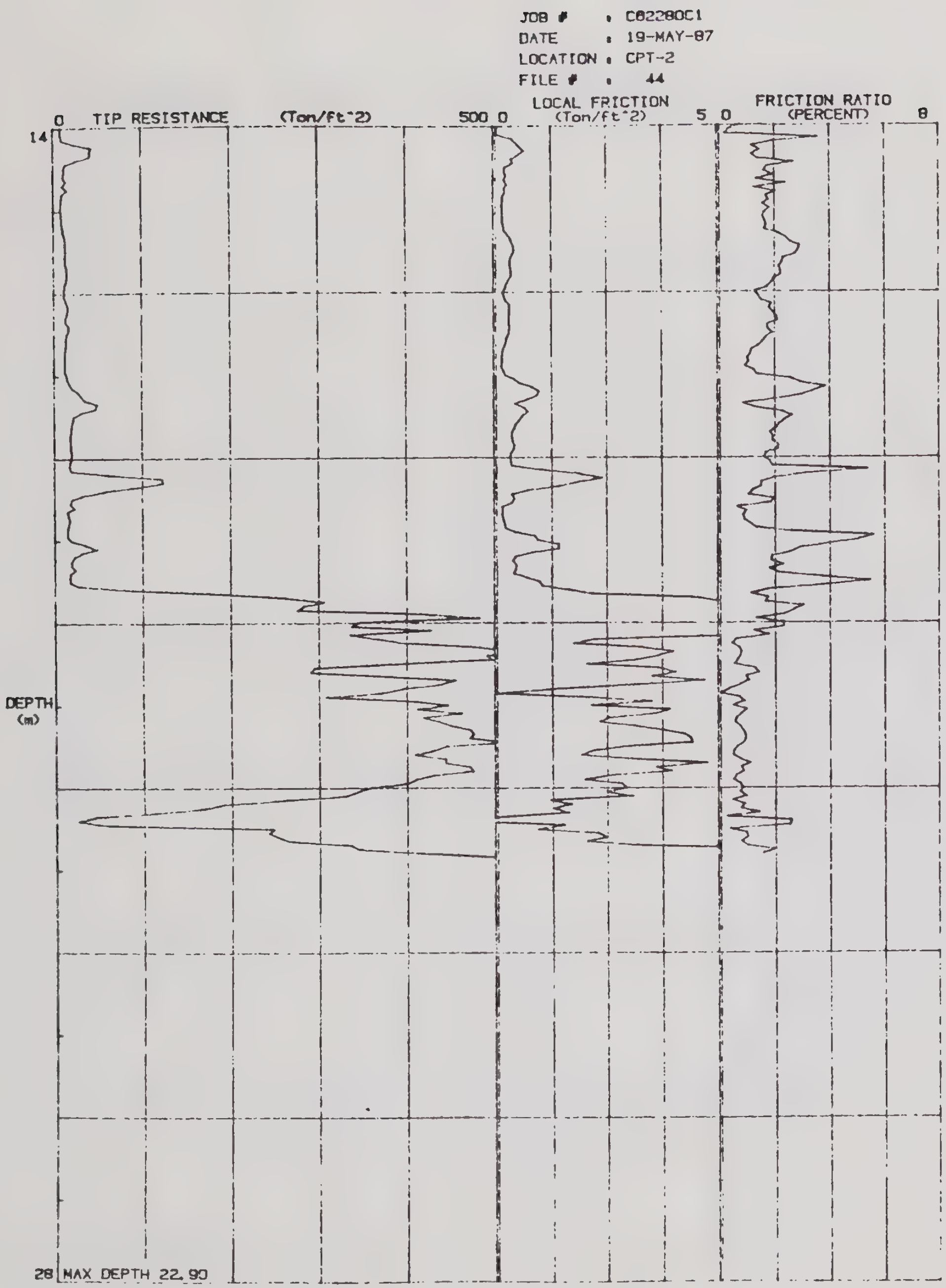


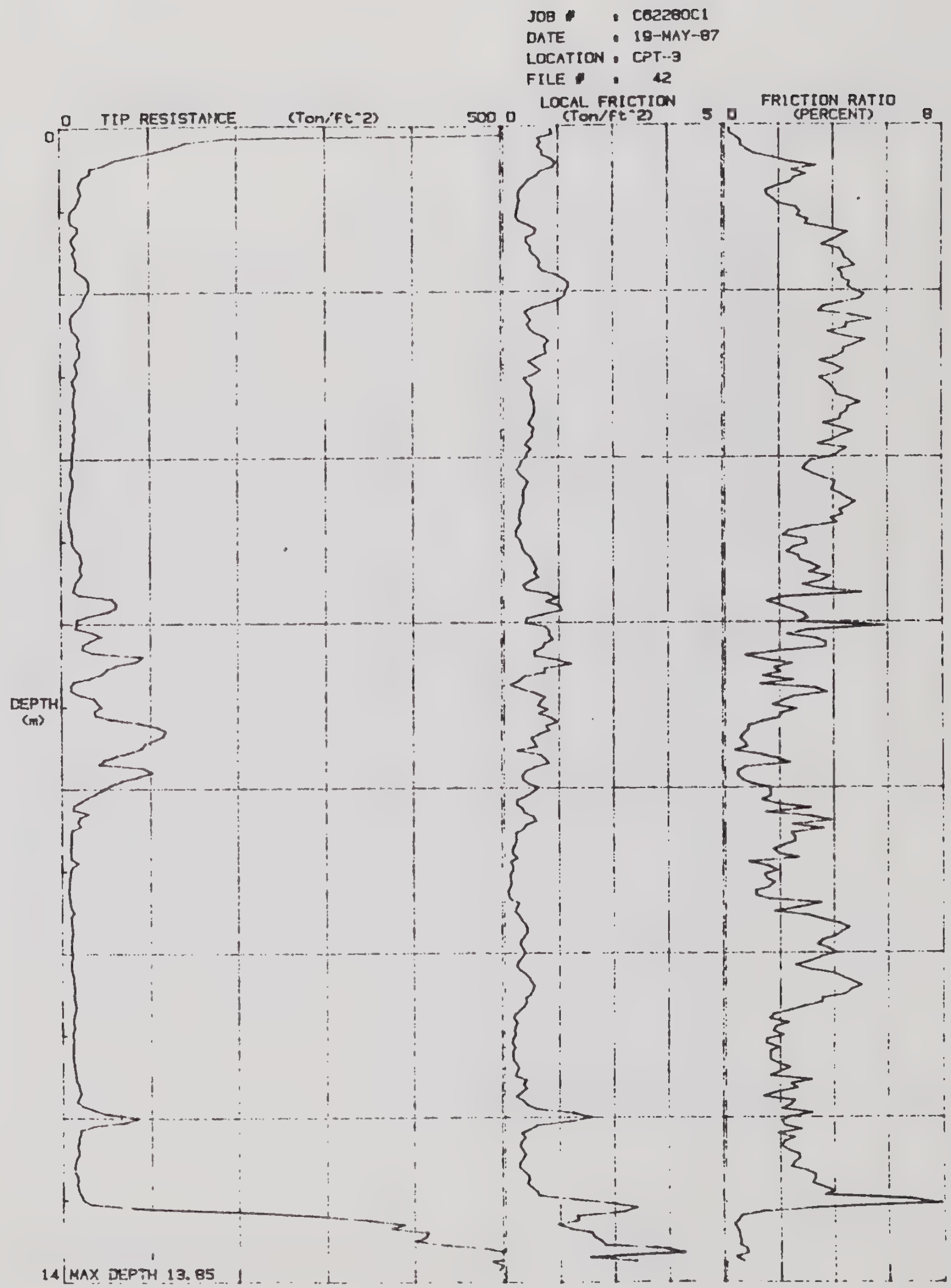
JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-1
FILE # : 40

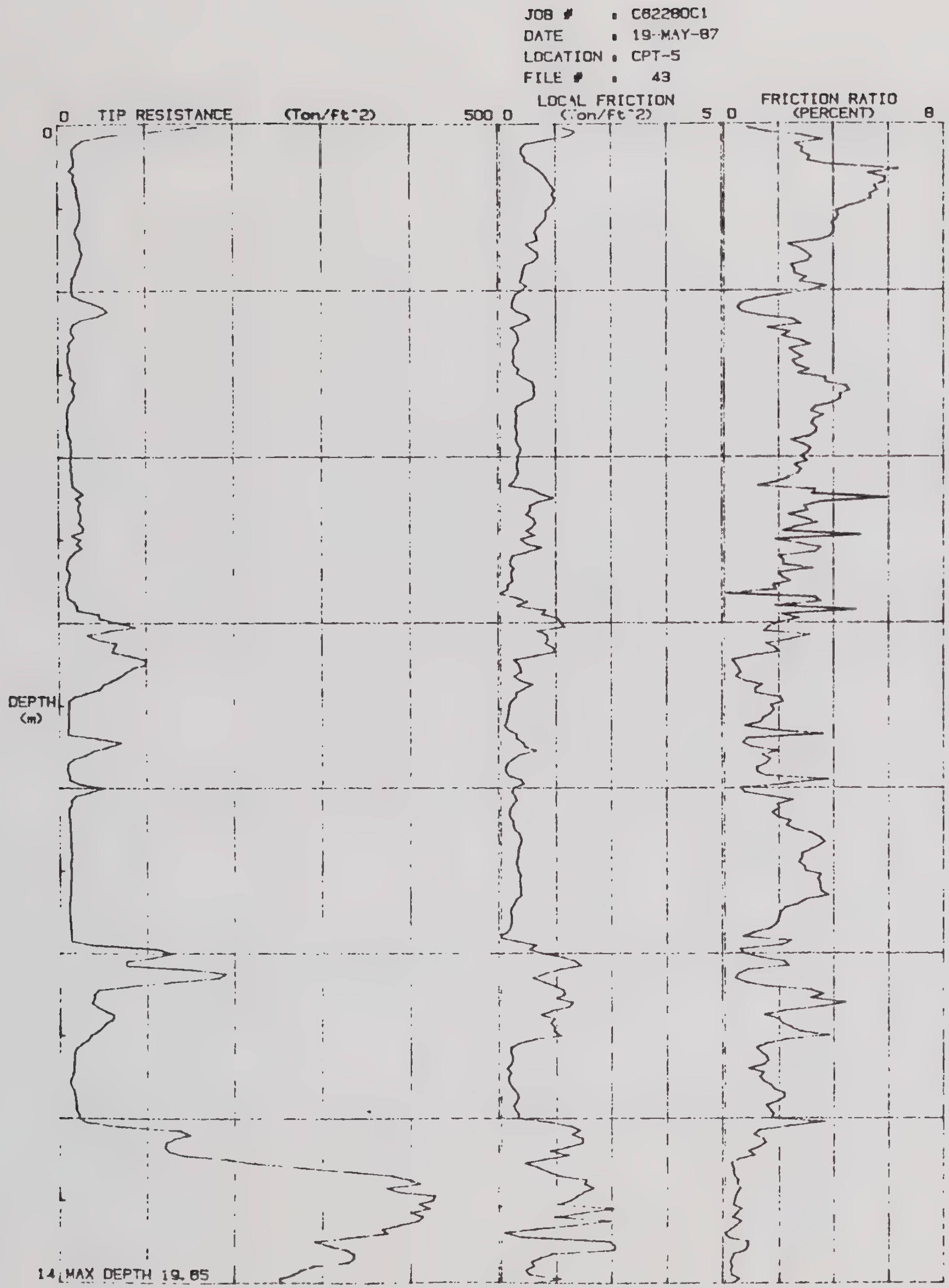


JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-2
FILE # : 44

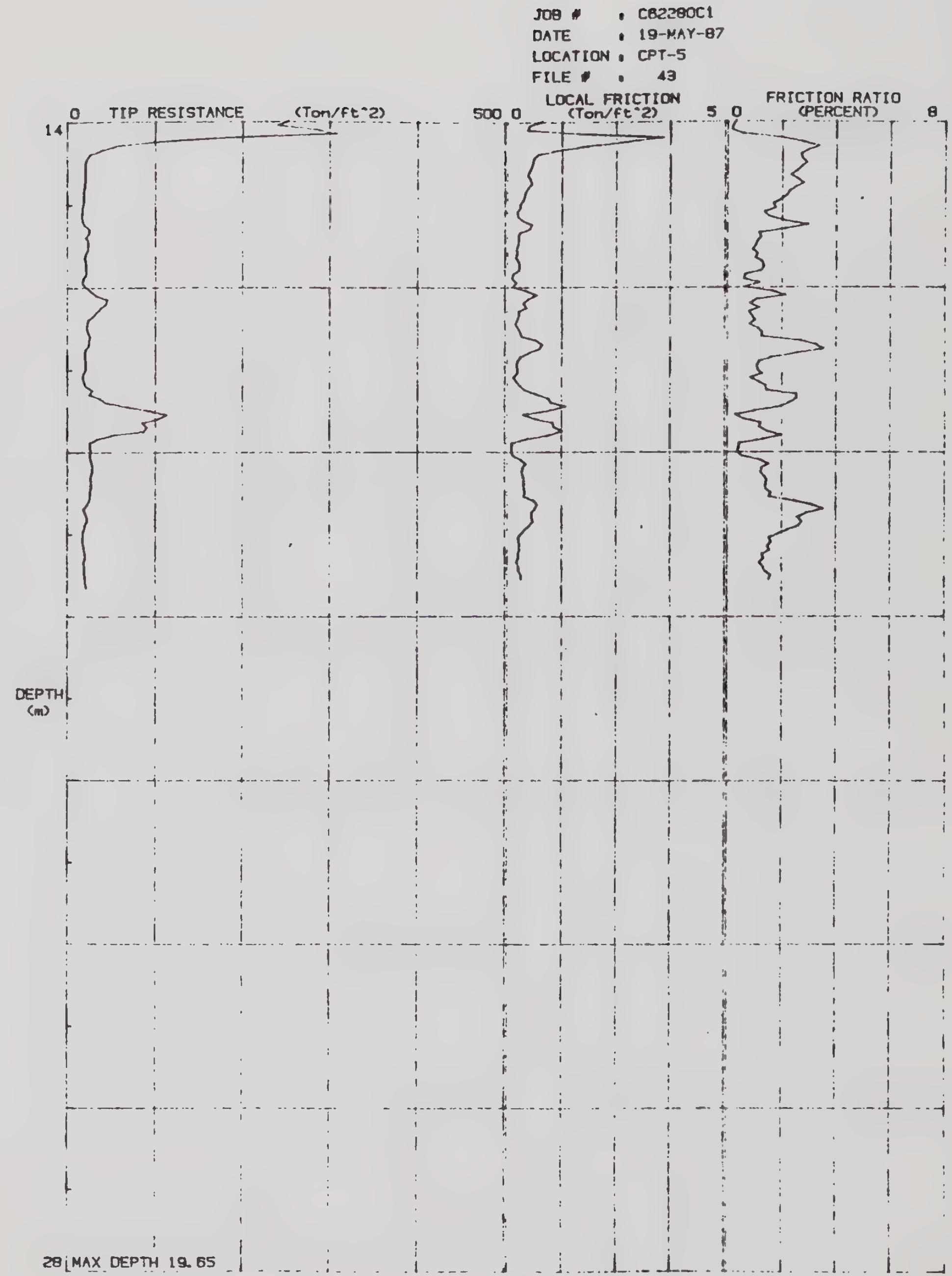



JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-2
FILE # : 44
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 22.90

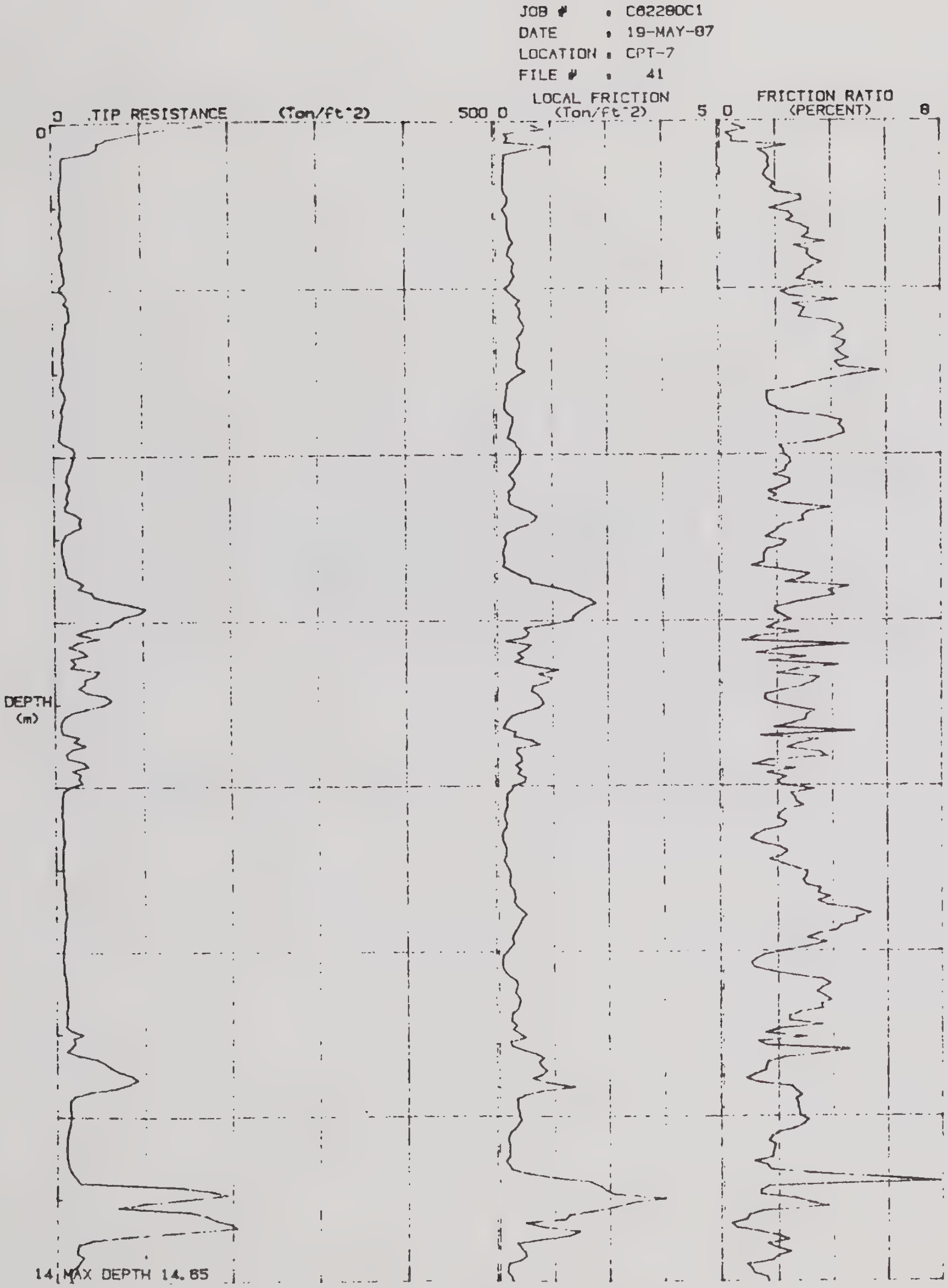

JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-3
FILE # : 42
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 13.85

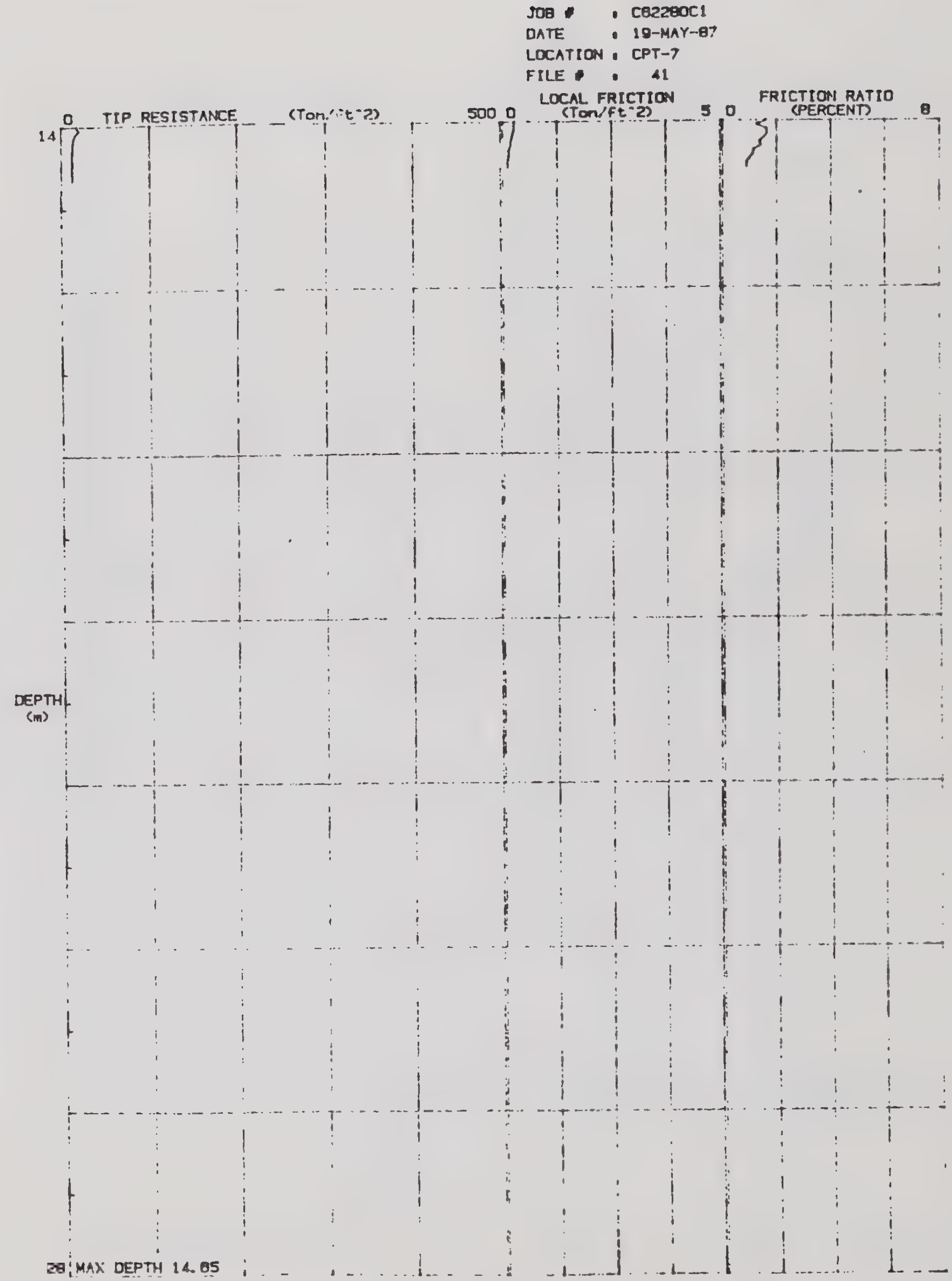

JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-5
FILE # : 43
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 19.65

A-7

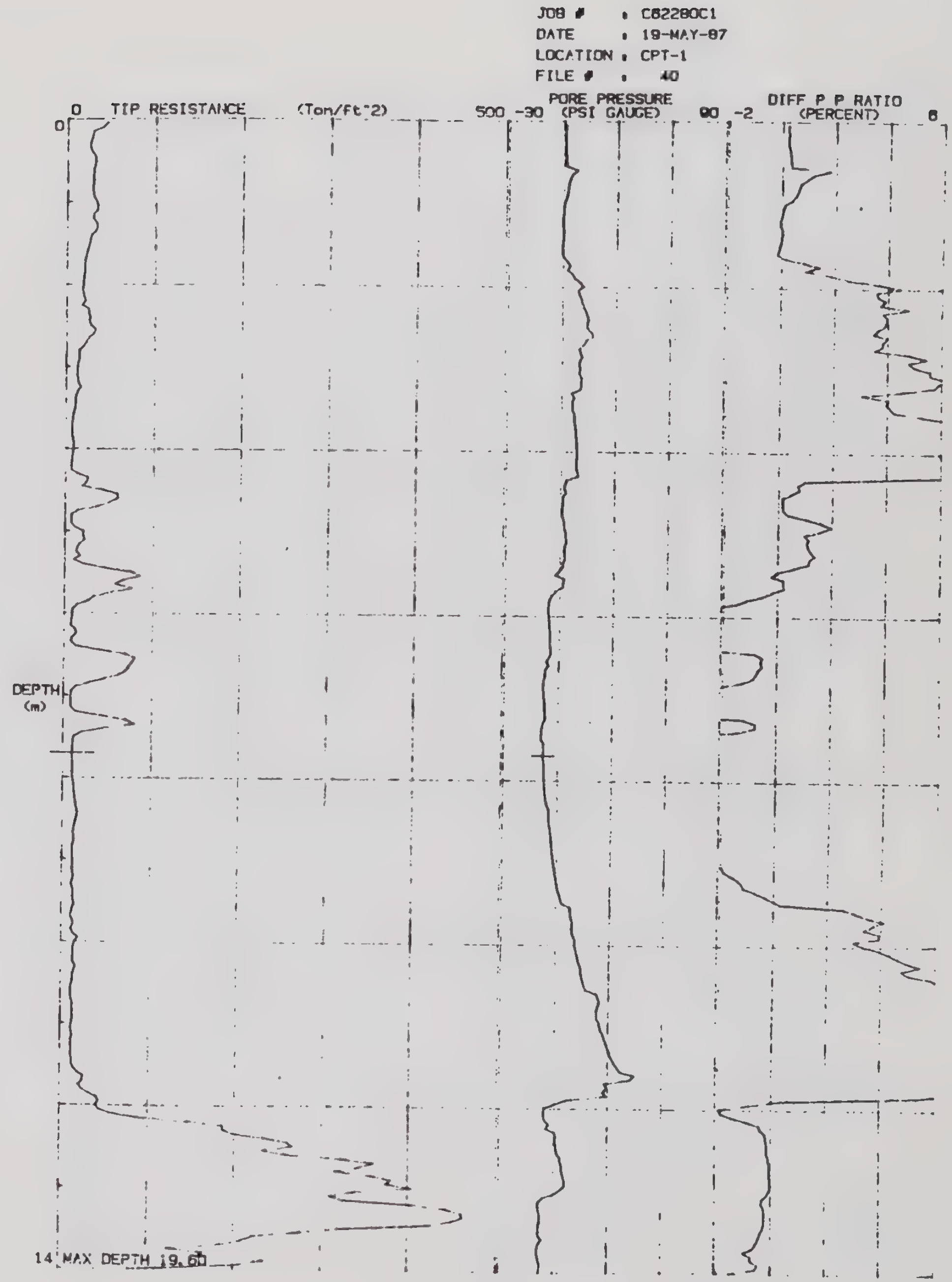

JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-5
FILE # : 43
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 19.65

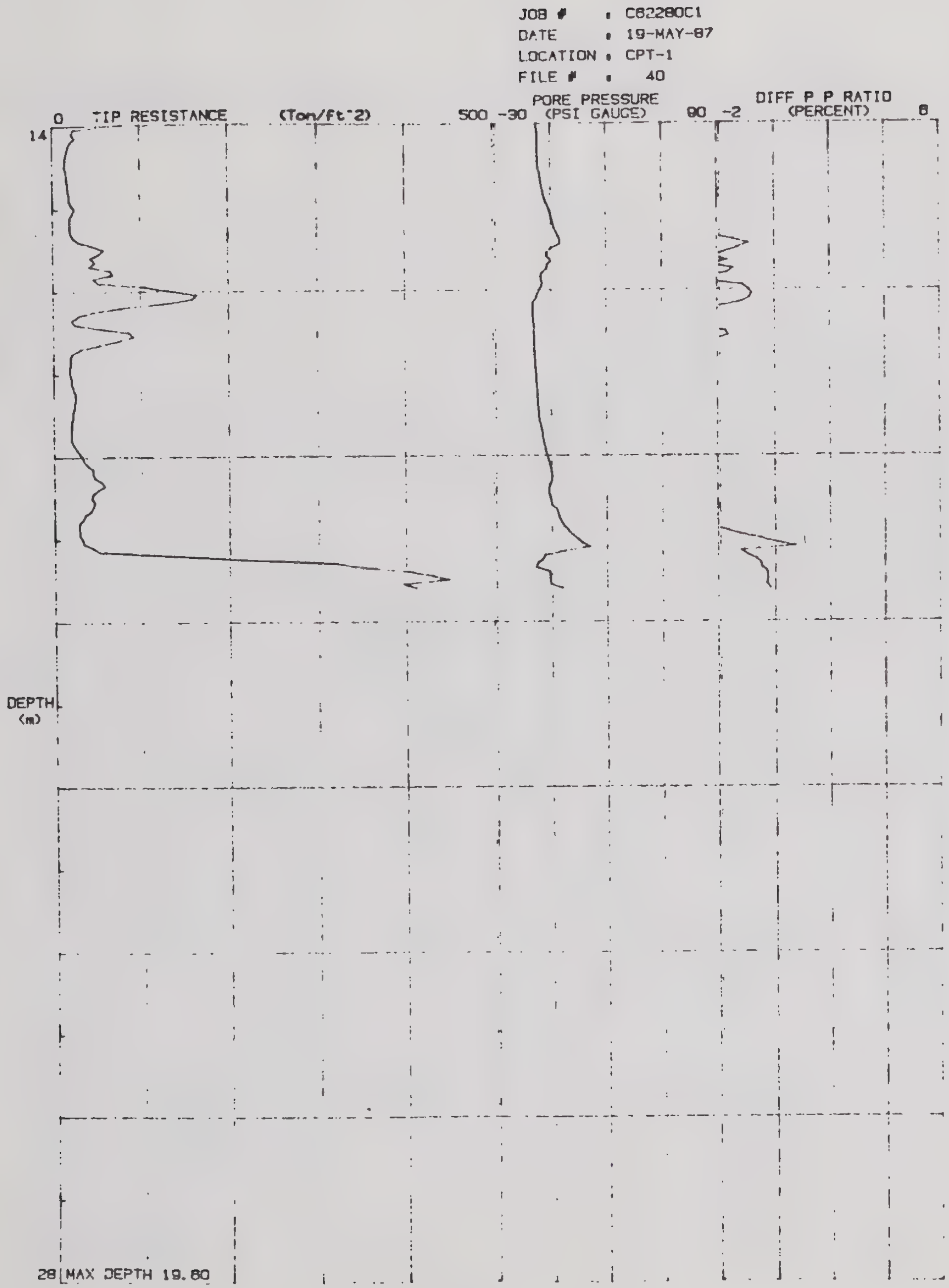
A-8

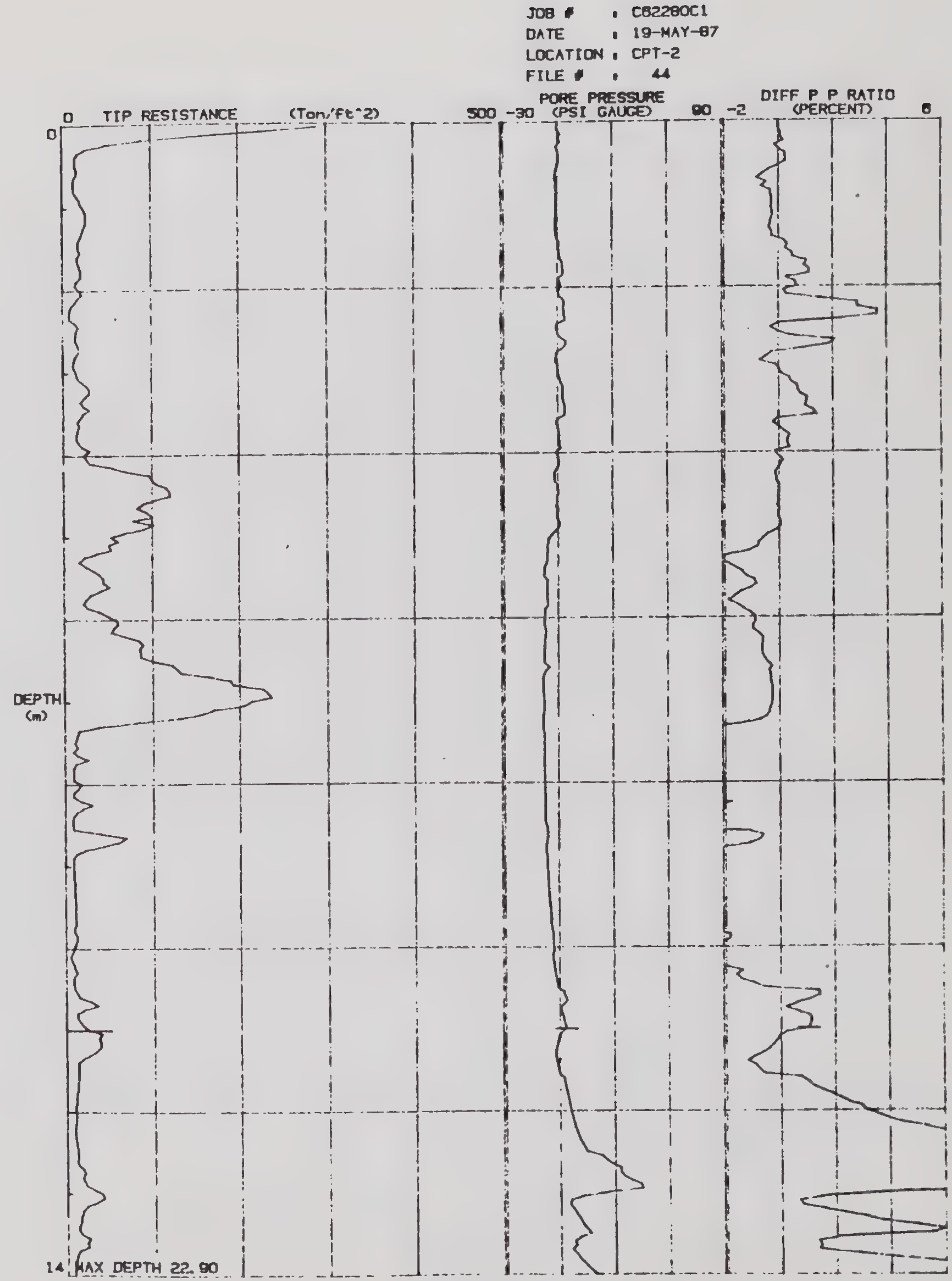

JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-7
FILE # : 41
TIP RESISTANCE (Ton/ft^2)
0
500
LOCAL FRICTION (Ton/ft^2)
0
5
FRICTION RATIO (PERCENT)
0
8
DEPTH (m)
0
14
MAX DEPTH 14.85

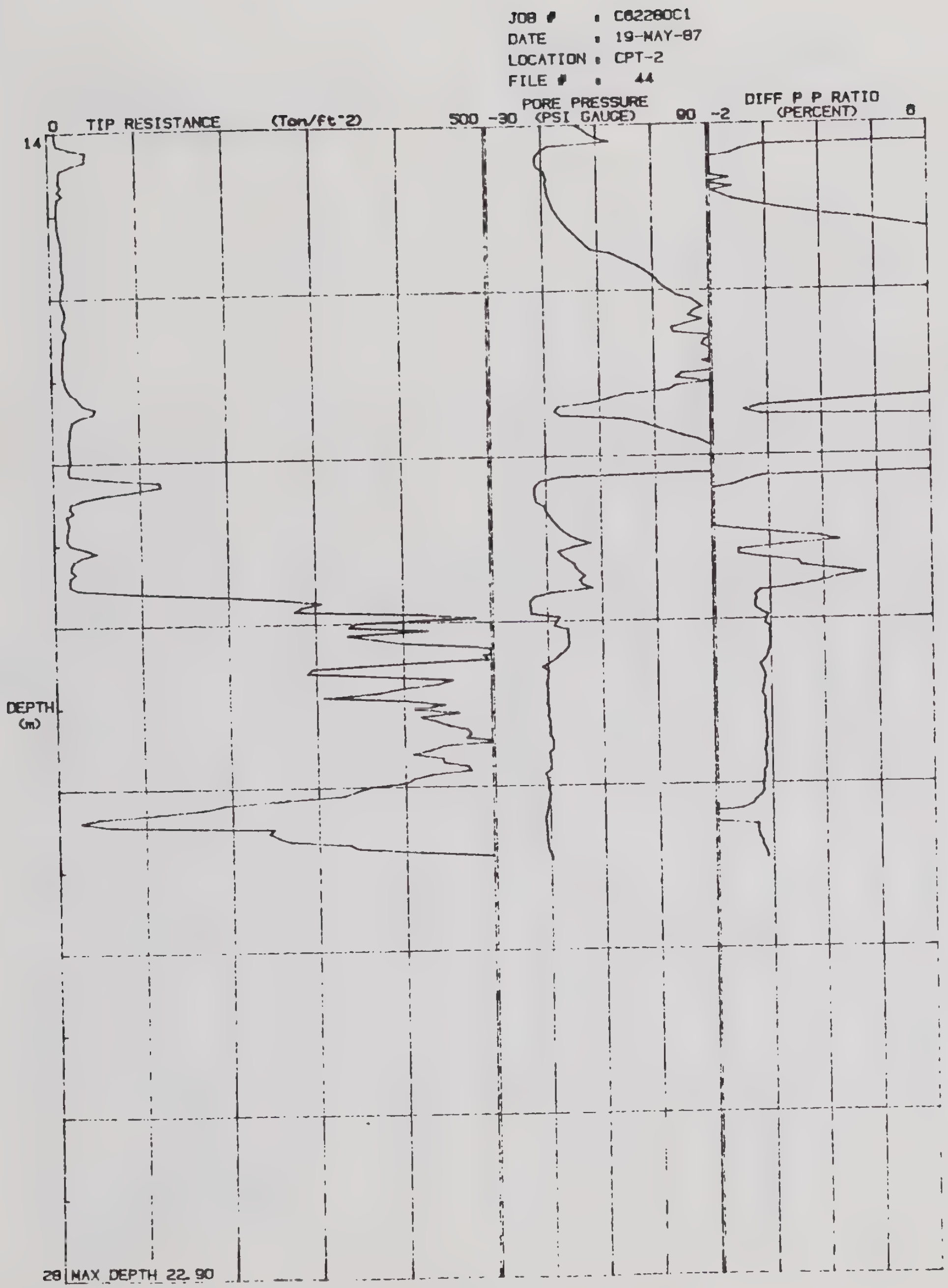

JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-7
FILE # : 41
TIP RESISTANCE (Ton/ft^2)
0
500
LOCAL FRICTION (Ton/ft^2)
0
5
FRICTION RATIO (PERCENT)
0
8
DEPTH (m)
14
28
MAX DEPTH 14.85

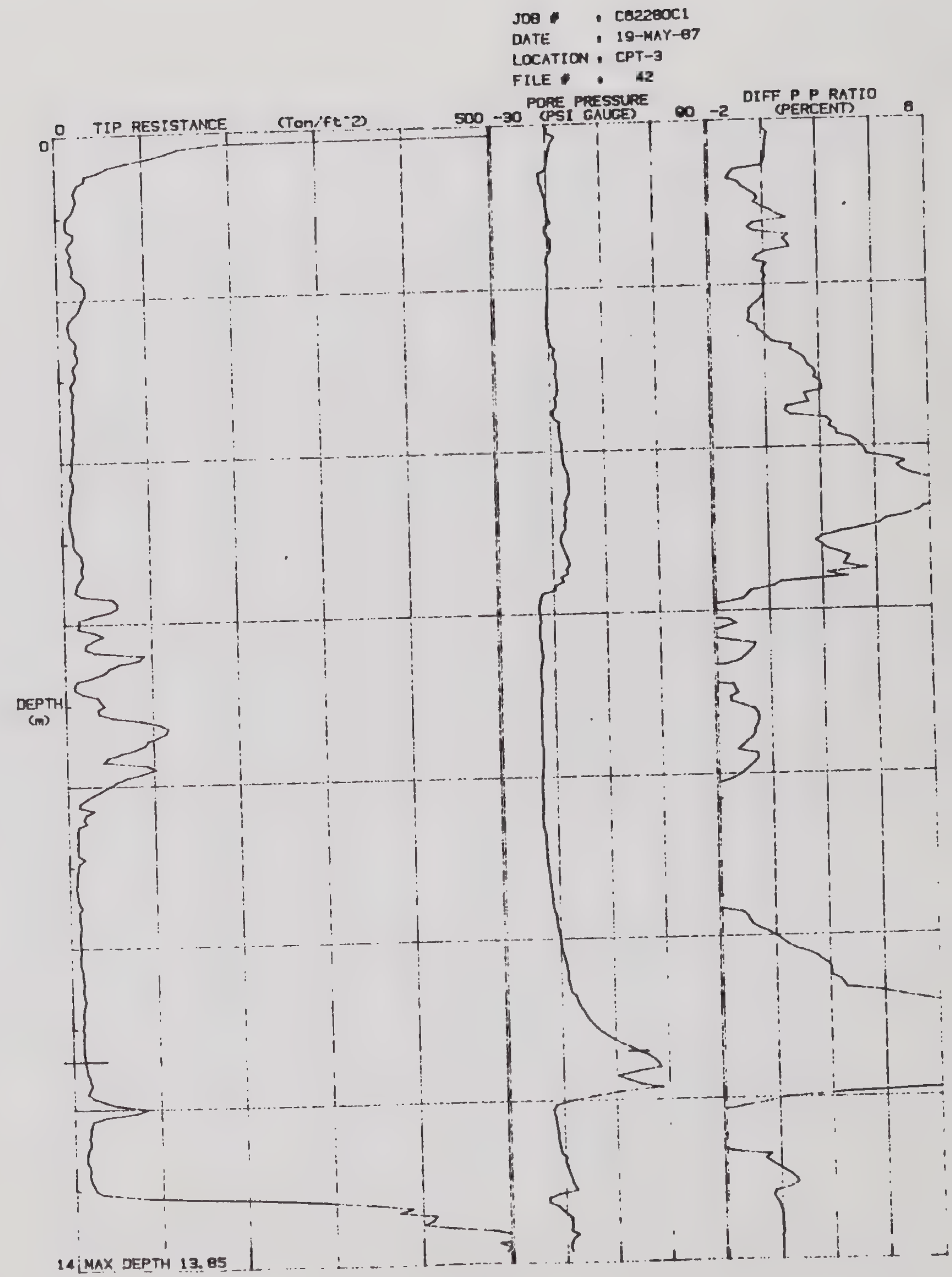
CPT Data: Tip Resistance, Pore Pressure, and Differential Pore Pressure Ratio

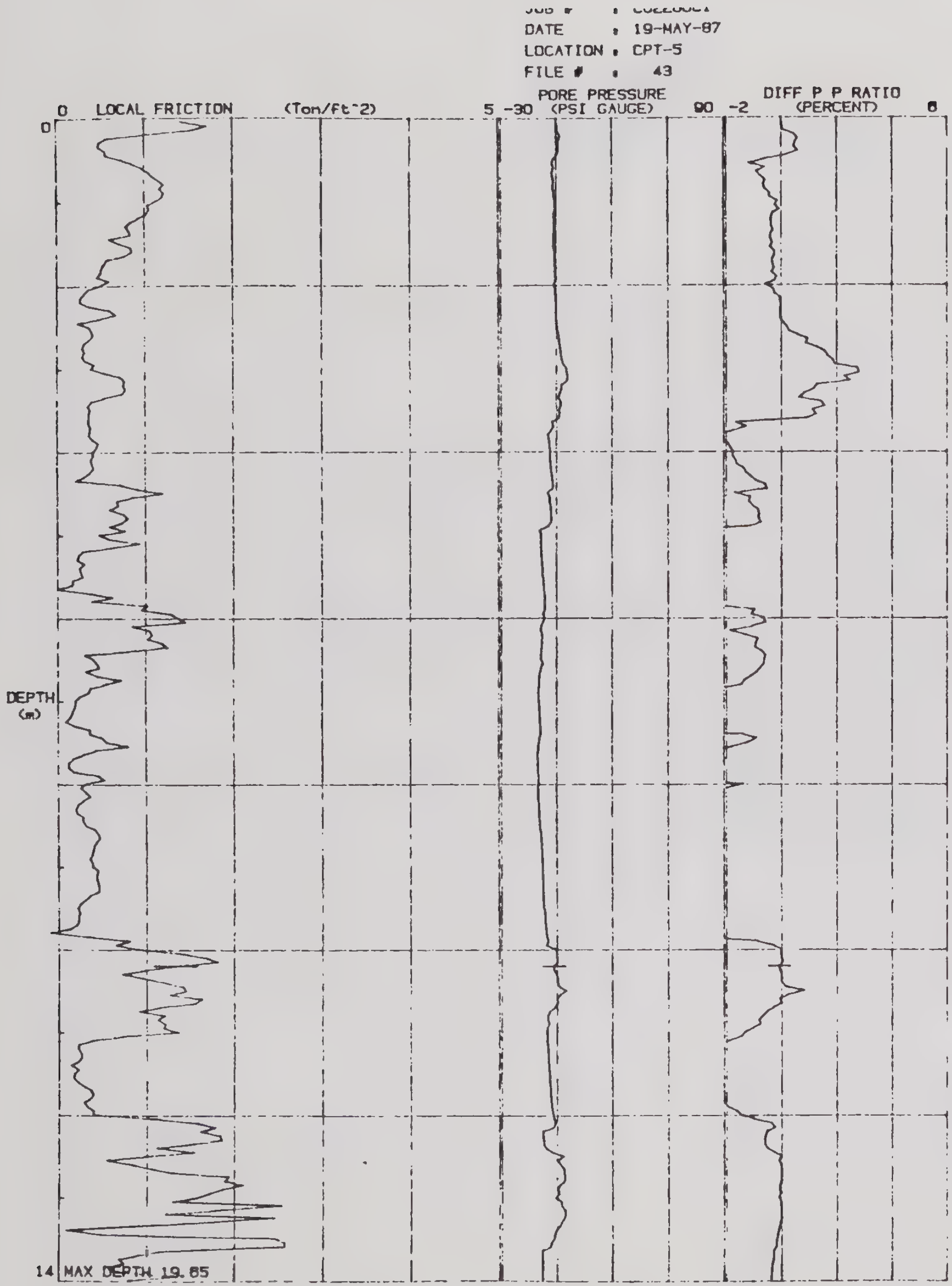



JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-1
FILE # : 40
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 6
14
DEPTH (m)
28 MAX DEPTH 19.80

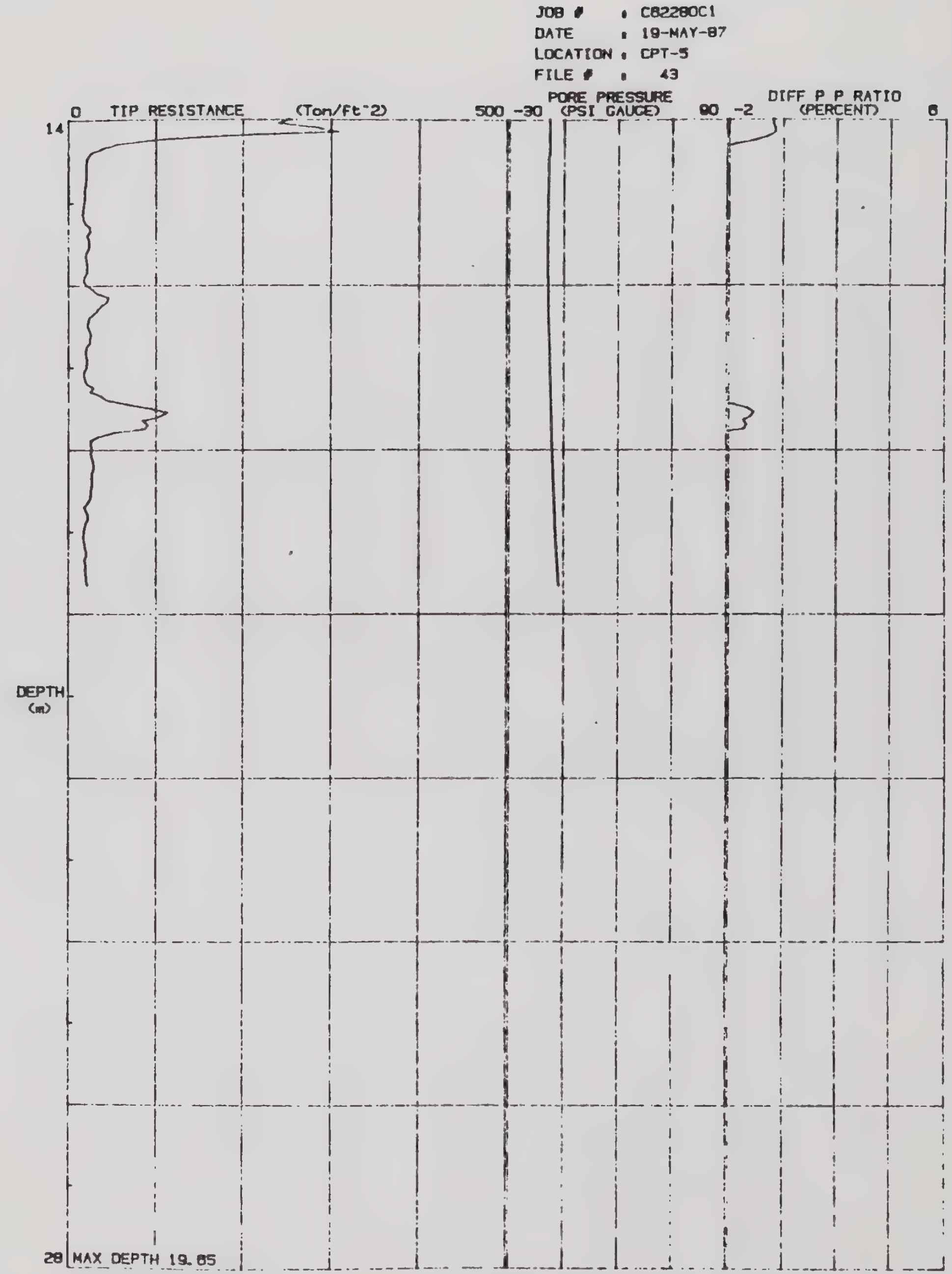

JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-2
FILE # : 44
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 6
0
DEPTH (m)
14 MAX DEPTH 22.90


JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-2
FILE # : 44
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 22.90


JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-3
FILE # : 42
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 13.85

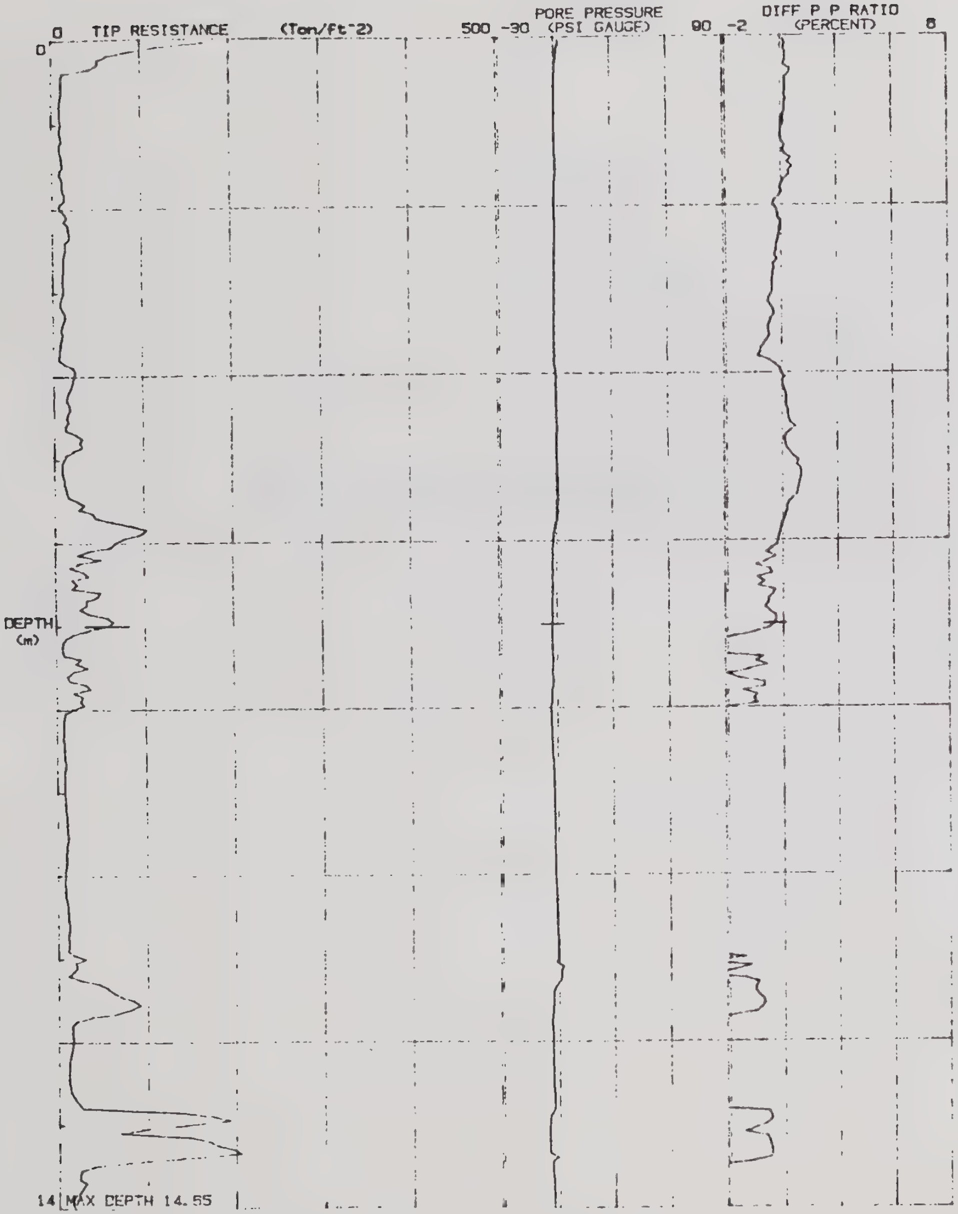


DATE : 19-MAY-87
LOCATION : CPT-5
FILE # : 43
0 LOCAL FRICTION (Ton/ft^2) 5
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 19.85

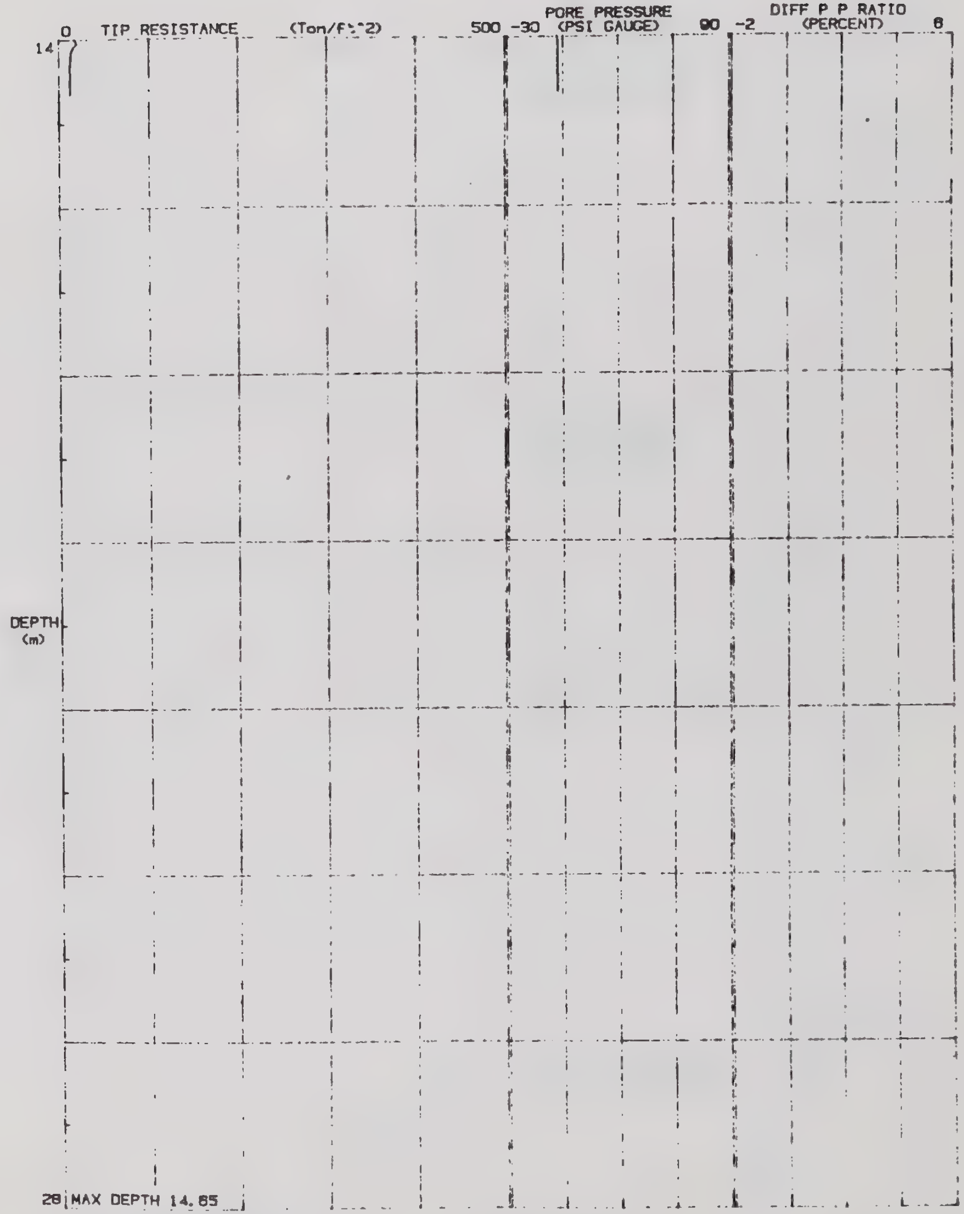


JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-5
FILE # : 43
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 19.85

JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-7
FILE # : 41

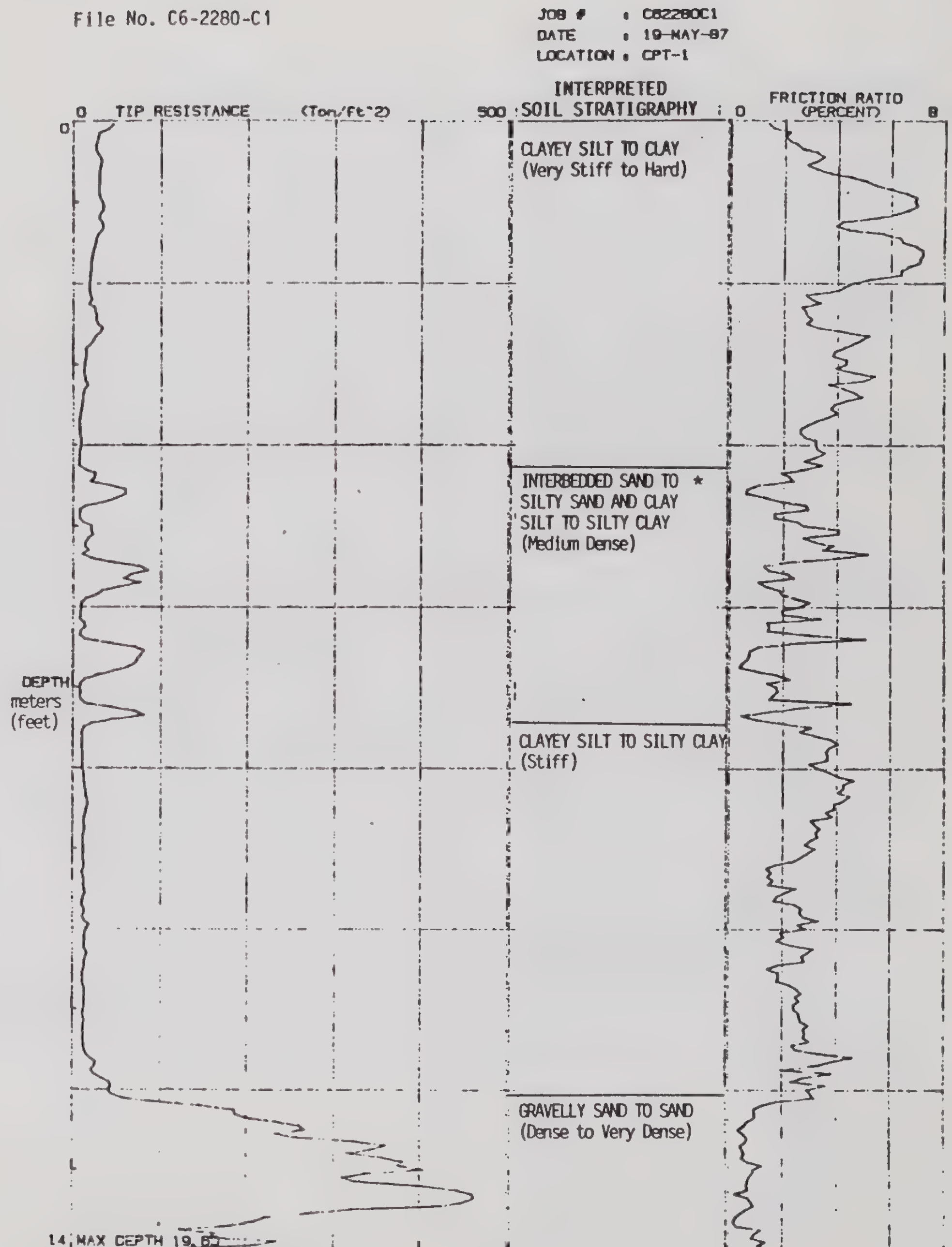


JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-7
FILE # : 41



CPT Data: Interpreted Soil Stratigraphy

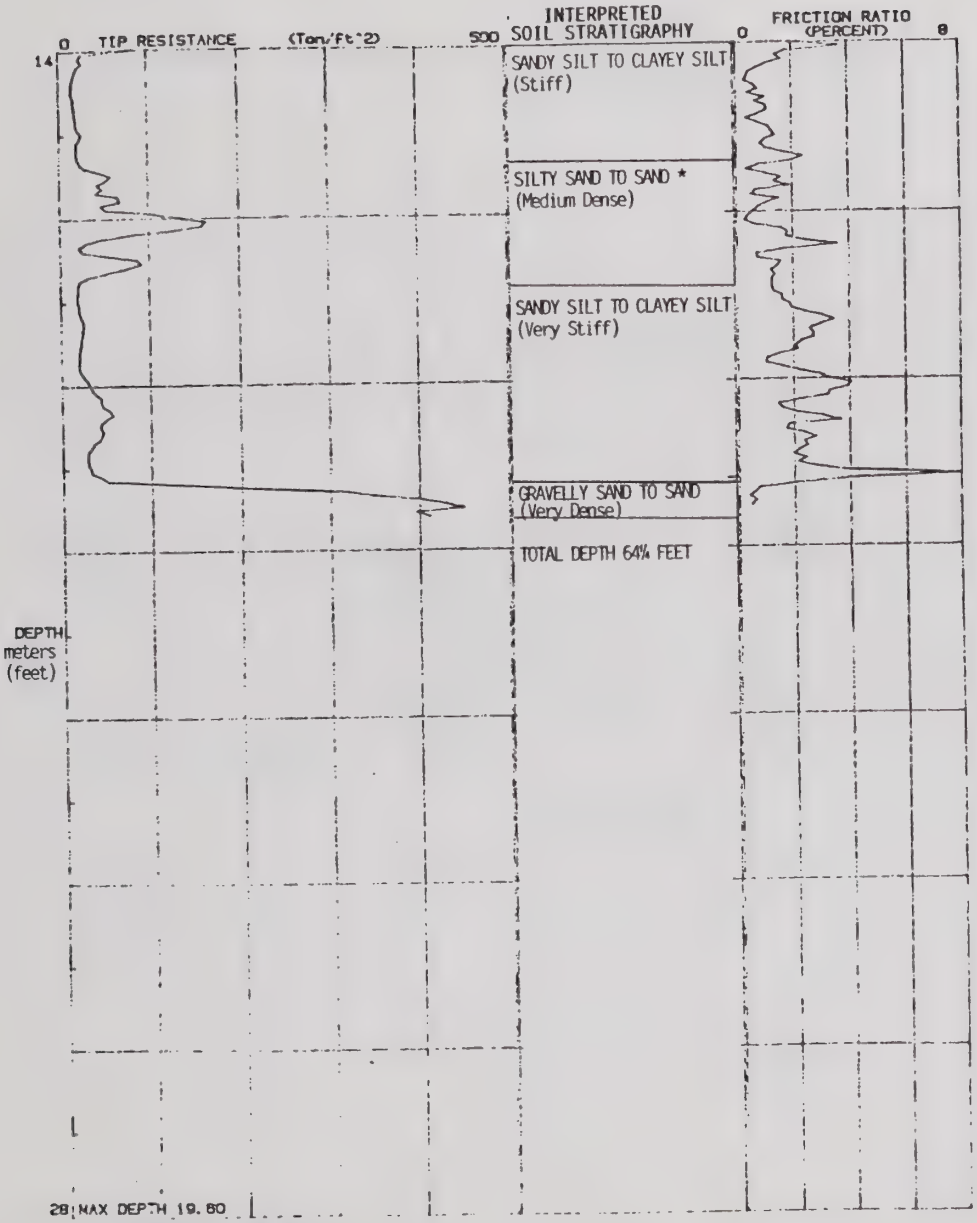
File No. C6-2280-C1



* Potentially Liquefiable

File No. C6-2280-C1

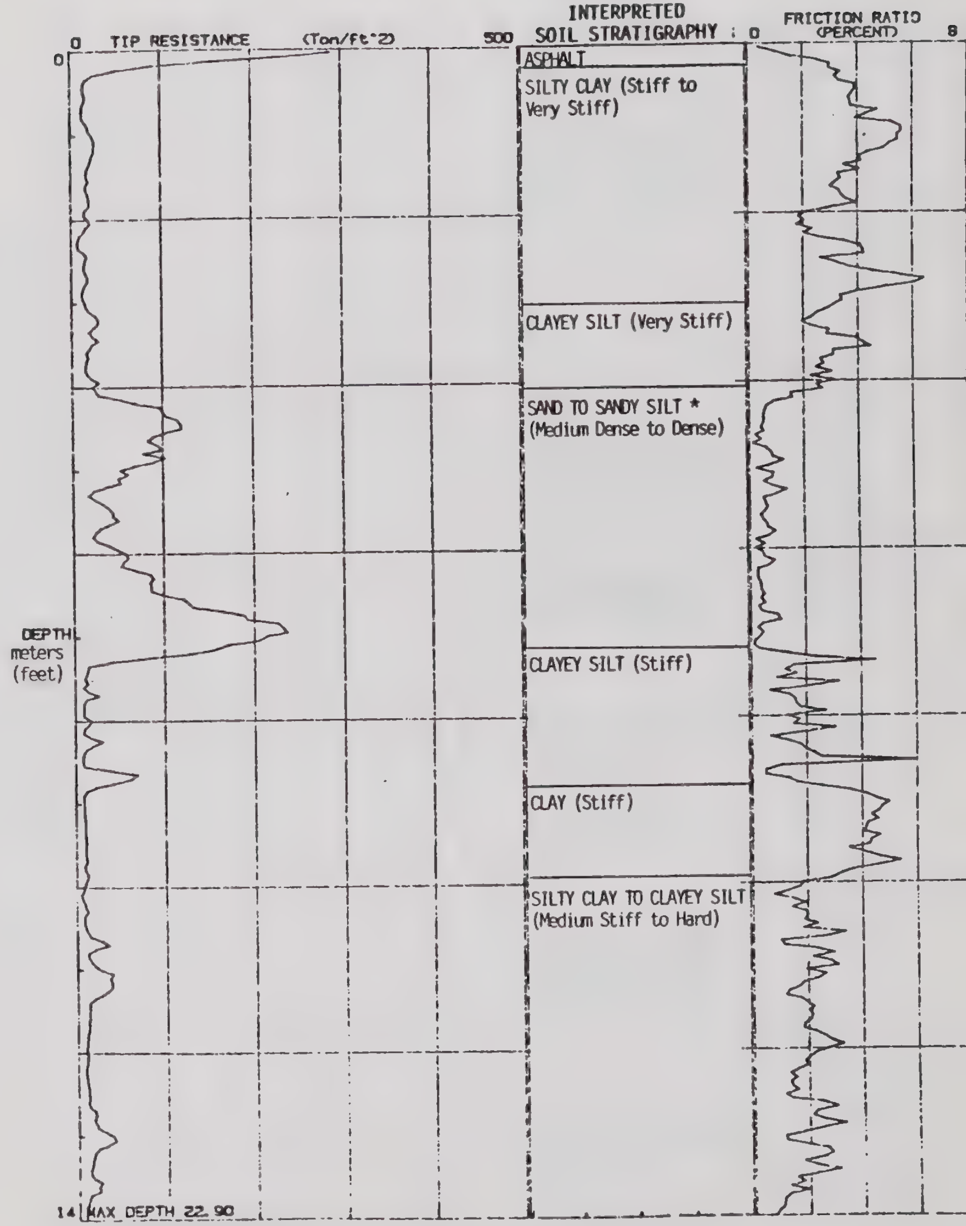
JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-1



* Potentially Liquefiable

File No. C6-2280-C1

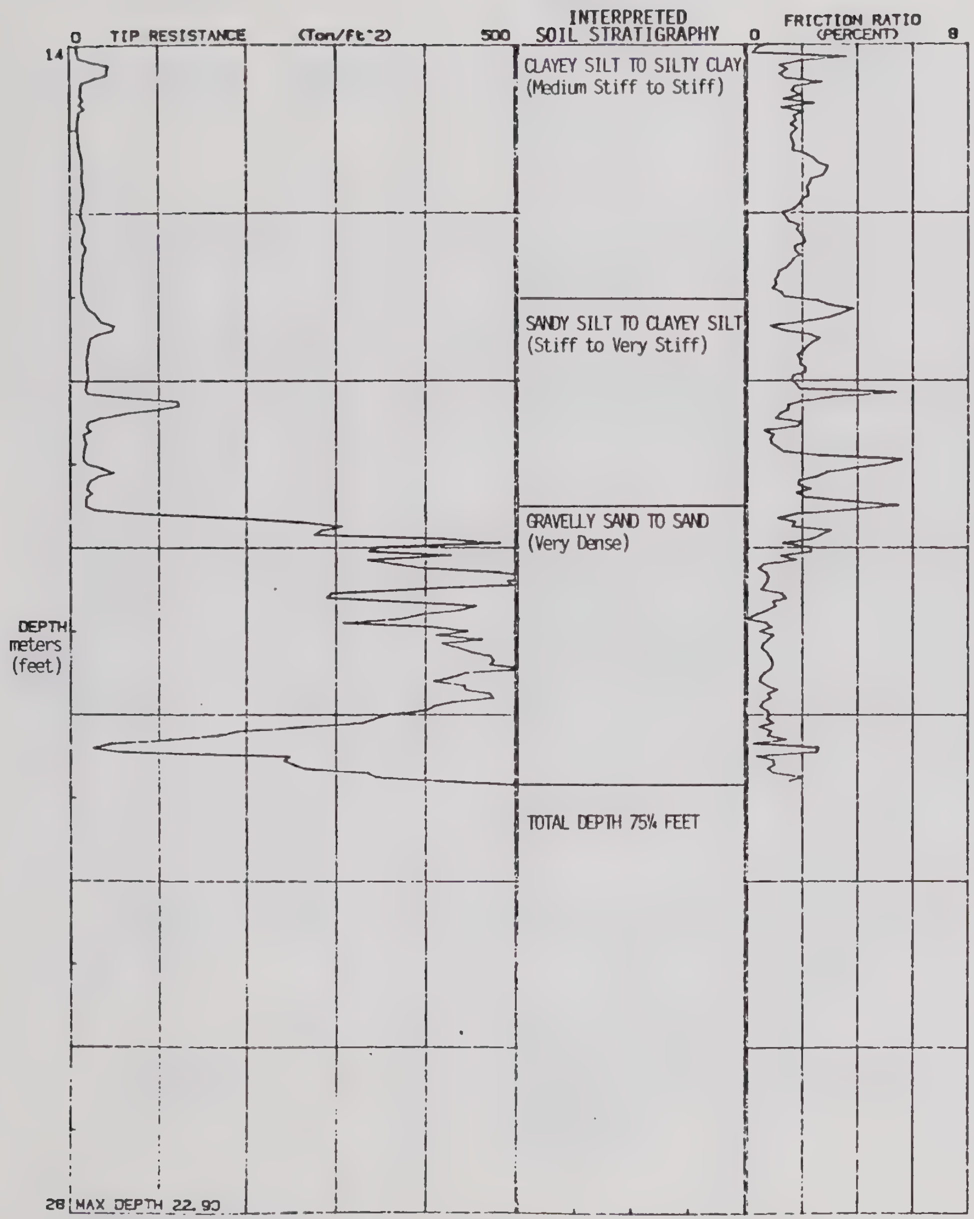
JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-2



(46) * Potentially Liquefiable

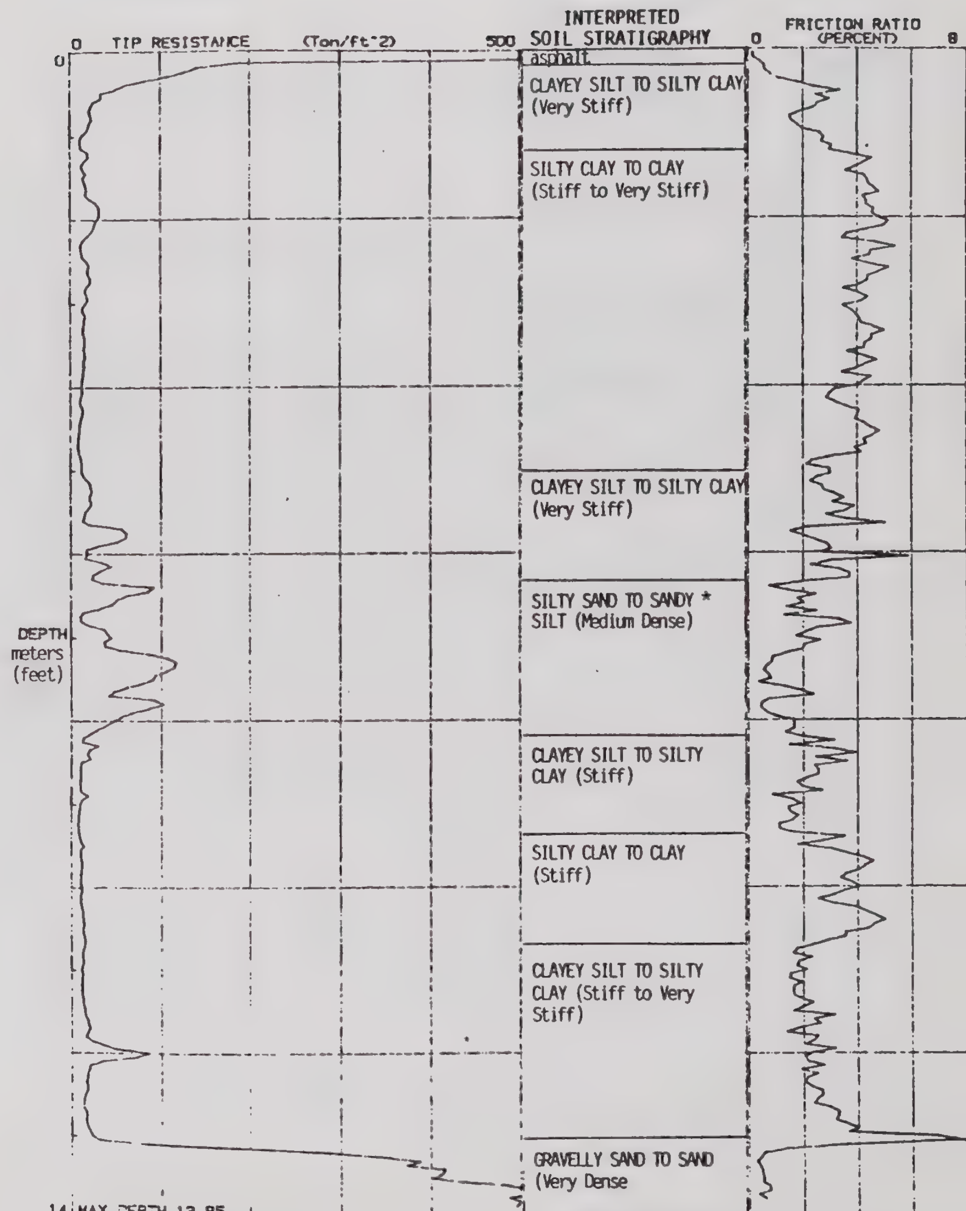
File No. C6-2280-C1

JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-2



File No. C6-2280-C1

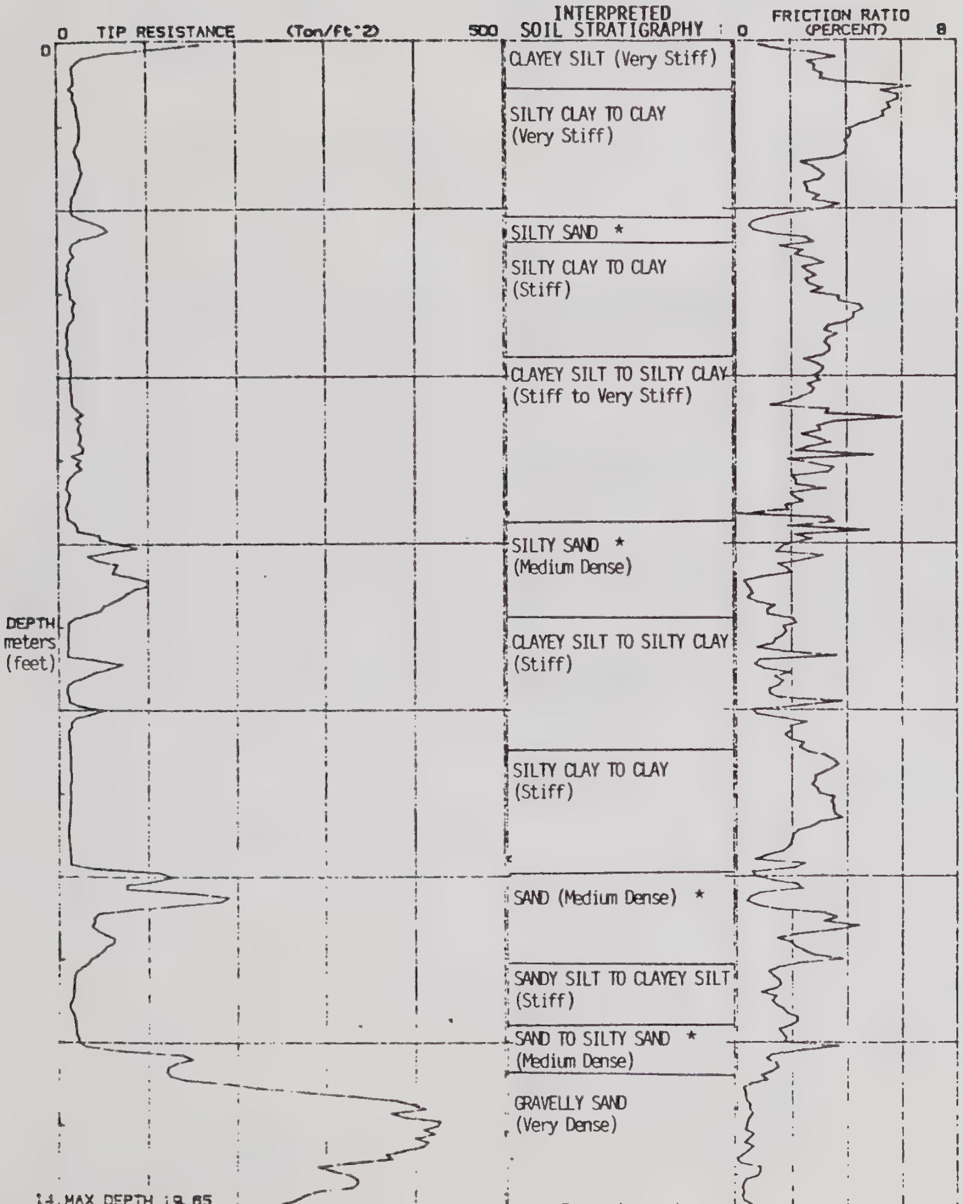
JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-3



* Potentially Liquefiable

File No. C6-2280-C1

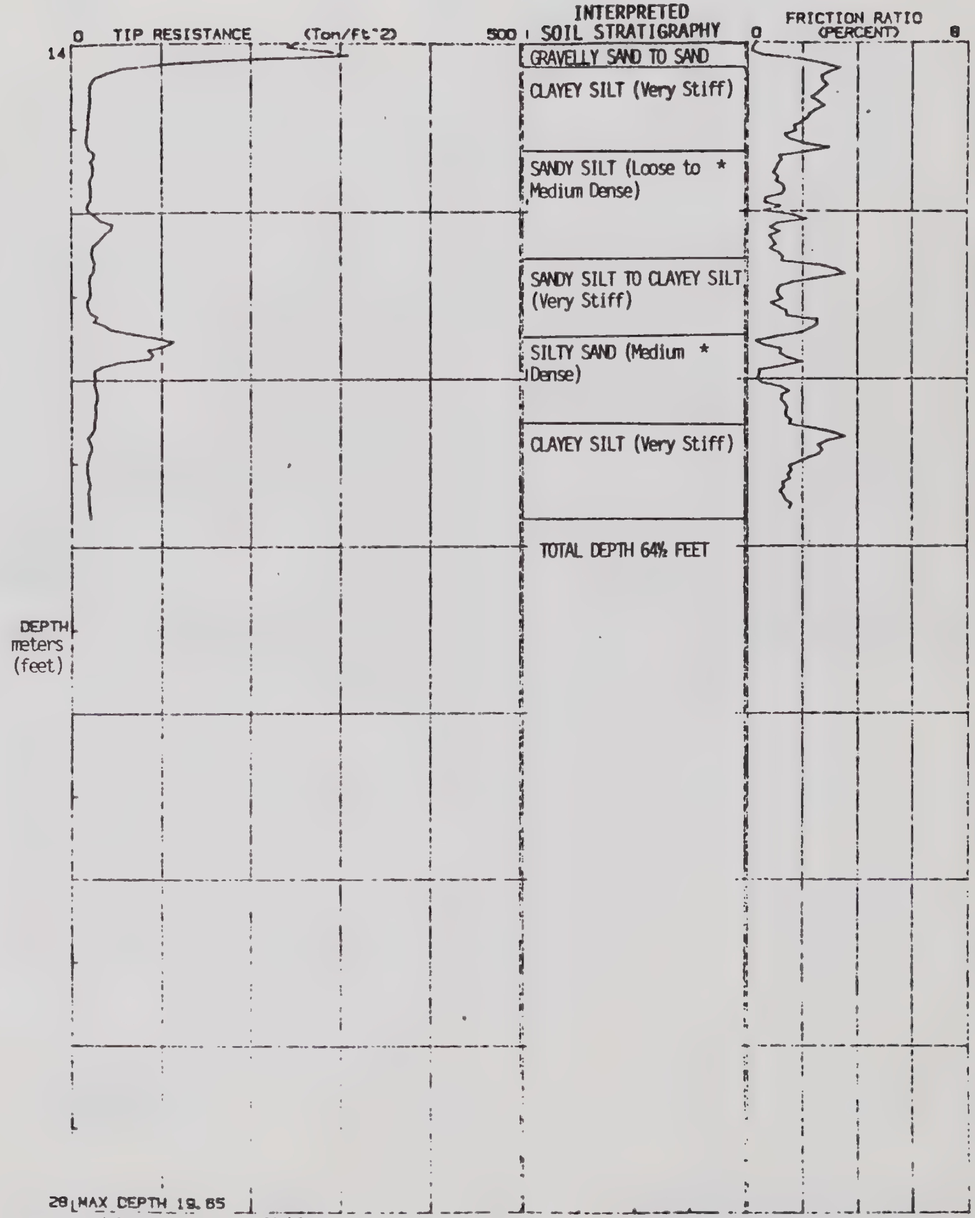
JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-5



* Potentially Liquefiable

File No. C6-2280-C1

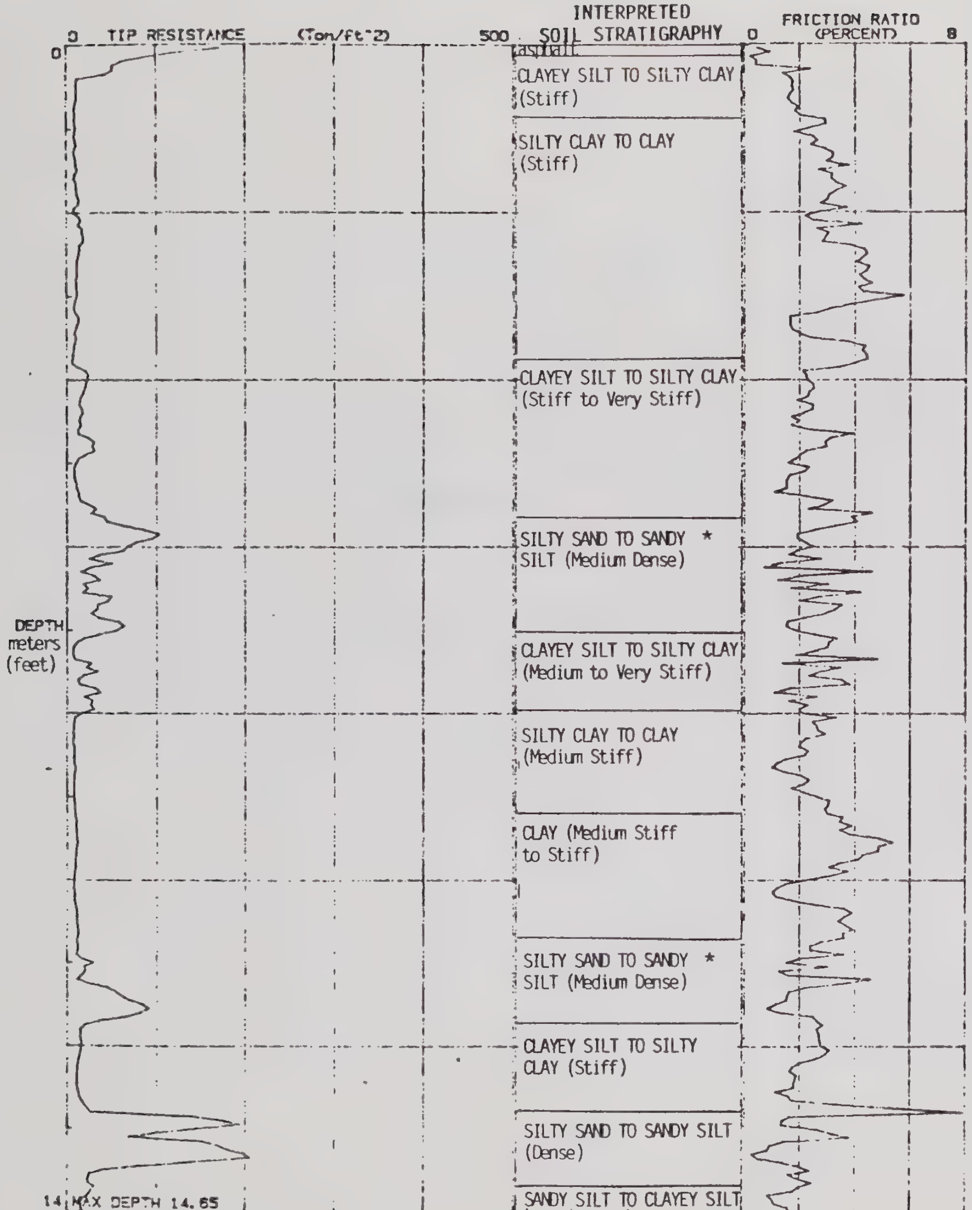
JOB # : C82280C1
DATE : 19-MAY-87
LOCATION : CPT-5



* Potentially Liquefiable

File No. C6-2280-C1

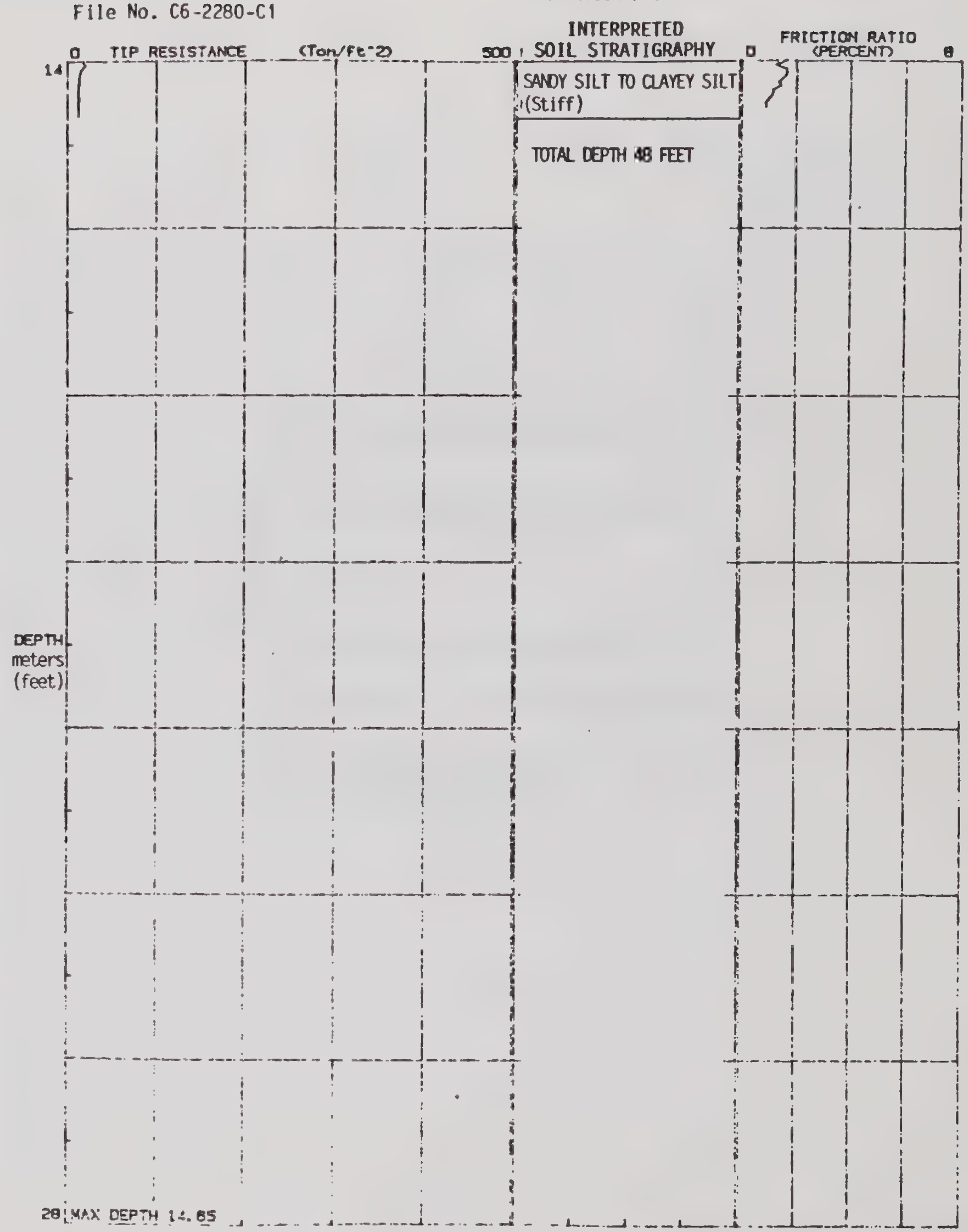
JOB # : C62280C1
DATE : 19-MAY-87
LOCATION : CPT-7



* Potentially Liquefiable

File No. C6-2280-C1

DATE : 19-MAY-87
LOCATION : CPT-7



Logs of Borings

KEY TO LOGS OF BORINGS

3" O.D. Modified California Sampler

Bulk Sample

Pocket Penetrometer Test (in tsf)

Groundwater Encountered During Drilling

(14) Estimated Standard Penetration Test Blow Counts (N Value)

File No. C6-2280-C1

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				Boring B2			
				4" Asphalt Concrete over 8" Baserock			
				Dark grey-brown silty CLAY, damp, hard (CH)			
5	B2-1		25 (19)		4.5+	91	26
				Grey-green silty CLAY, very moist, very stiff (CL)	2.5 / 1.5		
10	B2-2		24 (19)			92	30
				Black silty CLAY, very moist, stiff (CH)			
				Green well-graded SAND, saturated, dense (SW)			
15	B3-3		39 (24)	Olive-tan sandy fine to coarse GRAVEL, saturated, dense (GW)		-	9
				Tan fine SAND, saturated, dense (SP)			
20	B2-4		51 (32)	-grading coarser		94	24
				Olive-tan fine to medium SAND, minor coarse clean sand, saturated, very dense (SP)			
25	B2-5		80/10" (50+)			-	20

Log continued on next page...

File No. C6-2280-C1

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring B2 - continued			
25				-continuing in SAND			
				Grey silty CLAY with minor peat, wet, medium stiff to stiff (CL) (Old Bay Mud)			
30	B2-6		22 (17)		0.6 / 1.0	78	41
				Grey fine sandy CLAY, wet, stiff (CL)			
35	B2-7		15 (12)		1.25	99	26
				Green-grey silty CLAY with sand, minor peat, wet, stiff (CL)	1.0		
40	B2-8		17 (13)			91	30

Boring terminated at 40 feet.
Drilled May 27, 1987.

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				**Boring B4**			
				8" Asphalt Concrete over 5" Concrete			
				Coarse GRAVEL with minor clay matrix (GC-GP)			
	B4-1		17 (13)	Orange-brown silty CLAY with sand, damp, very stiff (CL)	2.5	96	20
5				-brick fragments			
	B4-2		52 (32)	Dark orange brown silty CLAY with minor peaty organics, moist, hard (CH)	4.5+	91	30
10				Dark grey brown silty CLAY, moist, very stiff (CH)			
	B4-3		40 (25)	Tan clayey SAND with minor fine gravel, widespread root lines, damp, dense (SC)	∇	117	14
15	B4-4		44 (27)	Tan fine GRAVEL (minor coarse) with well-graded sand matrix, clean, moist to wet, dense (GP-SW)	∇	126	11
20	B4-5		20 (12)	Olive-tan well-graded SAND with fine gravel, saturated, medium dense (SW)		128	12
25				Log continued on next page...			

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION		IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				**Boring B4 - continued**			
				-continuing in SAND			
30	B4-6		17 (13)	Grey silty CLAY, saturated, stiff (CH) (Old Bay Mud)	1.25	85	37
35	B4-7		21 (16)	Green grey sandy CLAY with occasional fine gravel, moist, Stiff (CL)	1.75	99	24
40	B4-8		20 (15)	Green grey fine sandy CLAY varying to silty CLAY with calcareous nodules, moist, stiff to very stiff (CL)	1.0 / 2.0	94	28
				Boring terminated at 40 feet. Drilled May 27, 1987.			

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				Boring B10		
				10" Asphalt Concrete		
				Brown subrounded GRAVEL (Baserock)		
	B10-1		20 (15)	Fill: Brown silty CLAY with sand, damp, dense (CL-SM) 3.0	93	7
5	B10-2		8 (6)	Tan silty CLAY, moist, medium stiff	108	16
				Tan sandy CLAY		
	B10-3		2/18"	Fine SAND (SP) -trench backfill	109	19
10						
	B10-4		25 (14)	Natural Ground: Mottled orange with grey clayey SAND, moist, medium dense (SC)	112	20
15						
	N.R.		68 (42)	Tan silty SAND, moist, dense (SM)		
20						
25				Grey silty SAND, saturated, medium dense (SM)		

Log continued on next page...

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				Boring B10 - continued		
	B10-5		15 (12)	Grey silty SAND, saturated, medium dense (SM) 0.75	92	30
				Grey silty CLAY, saturated, medium stiff to stiff (CH) (Old Bay Mud)		
30				Orange-grey sandy CLAY, saturated, stiff (CL)		
	B10-6		36 (24)	-with abundant gravel, subround, miscellaneous, 1/2" 1.75	104	20
35						
				Orange grey mottled silty CLAY, moist, stiff (CL)		
	B10-7		49 (31)	-with 1/4 to 1" gravels 1.5	100	25
40				Boring terminated at 40 feet. Drilled May 27, 1987.		

APPENDIX B

Summary of Laboratory Test Results

Grain Size Analysis Results

Consolidation Test Results

File No. C6-2280-C1
July 20, 1987

Table 1

Summary of Moisture, Density, Swell and Direct Shear Testing

Sample Number	Depth (Ft.)	In-Place Conditions Dry Density pcf	 Moisture Content % Dry Wt	Swell Tests Swell Index (A)	 % Swell	 Moisture Increase % (B)	Direct Shear Testing Angle Of Internal Friction Degrees	 Unit Cohesion psf
B1-1								
B2-2	9	92	30					1775 (u)
B2-3								
B2-4	19	94	24	See Grain Size Analysis				
B2-5								
B2-6	30	78	41					550 (u)
B2-7	34	99	26					725 (u)
B2-8								
B4-1								
B4-2								
B4-2								
B4-4	18	126	11	See Grain Size Analysis				
B4-5	23	128	12	See Grain Size Analysis				
B4-6	28	88	35	Specific Gravity = 2.68				900 (u)
B4-6				See Consolidation Test				
B4-7								
B4-8								
B10-1								
B10-2								
B10-3								
B10-4	3	112	20	See Grain Size Analysis				
B10-5	25	97	24	See Grain Size Analysis				
B10-5	25	92	30	0.0	0.0	0.9	-	1940*
B10-6								
B10-7								

NOTES:
(A) - Swell Index equals percent swell divided by percent moisture increase.

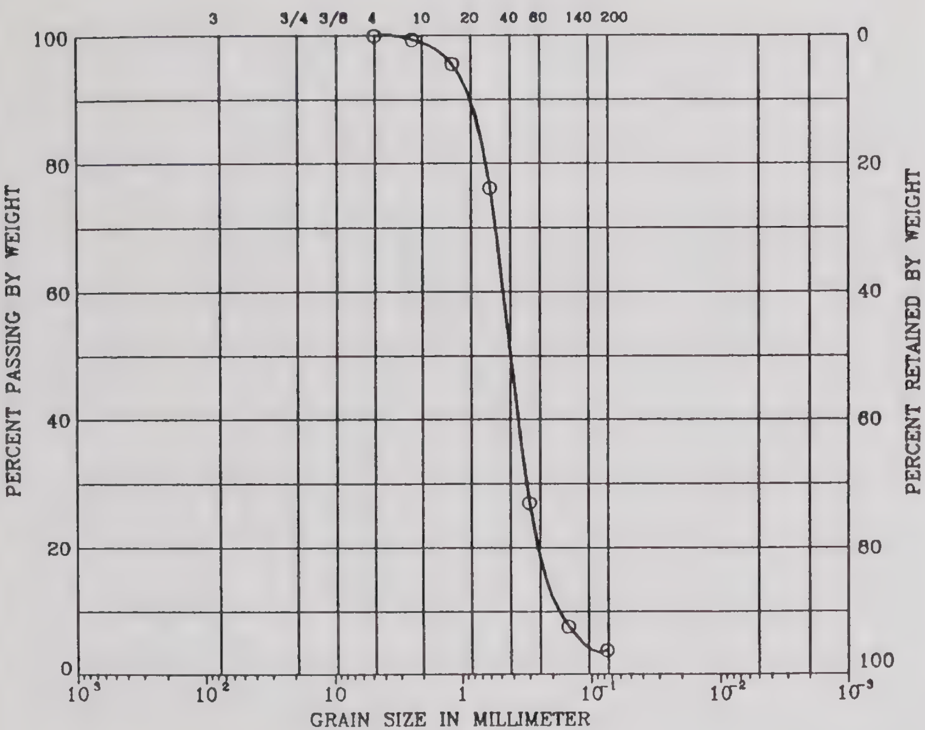
(B) - Moisture Increase following at least 24 hours of soaking prior to testing.

* - Determined with the direct shear test at a normal stress of 3000 psf.

(u) - Strength obtained from Unconfined Compression Test.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	B2-4-1				Dark gray brown and olive poorly-graded SAND (SP)

Remark :

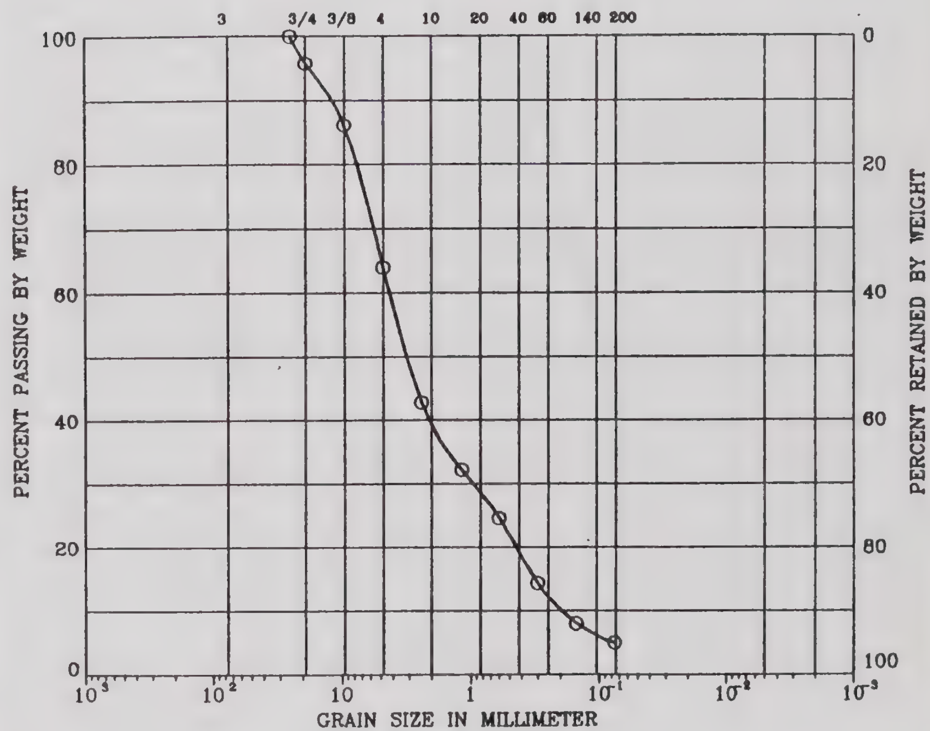
C6-2280-C1

Earth Systems

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



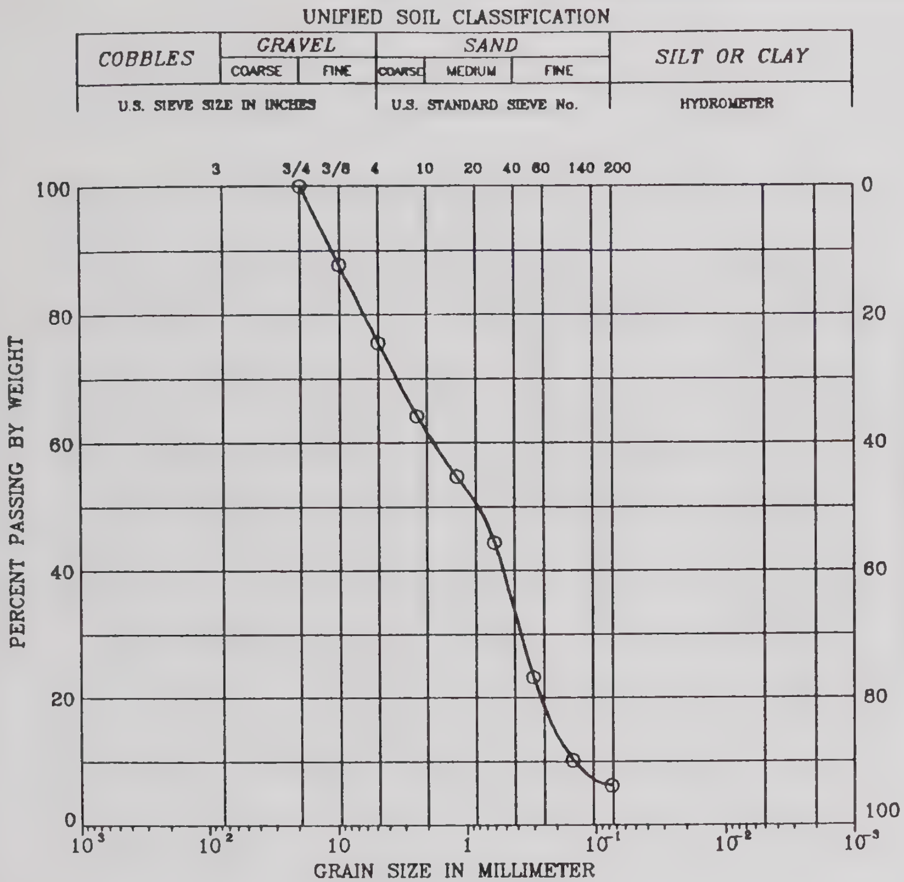
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	B4-4	17.5			Dark grayish brown well graded SAND w/gravel (SW)

Remark :

C6-2280-C1

Earth Systems

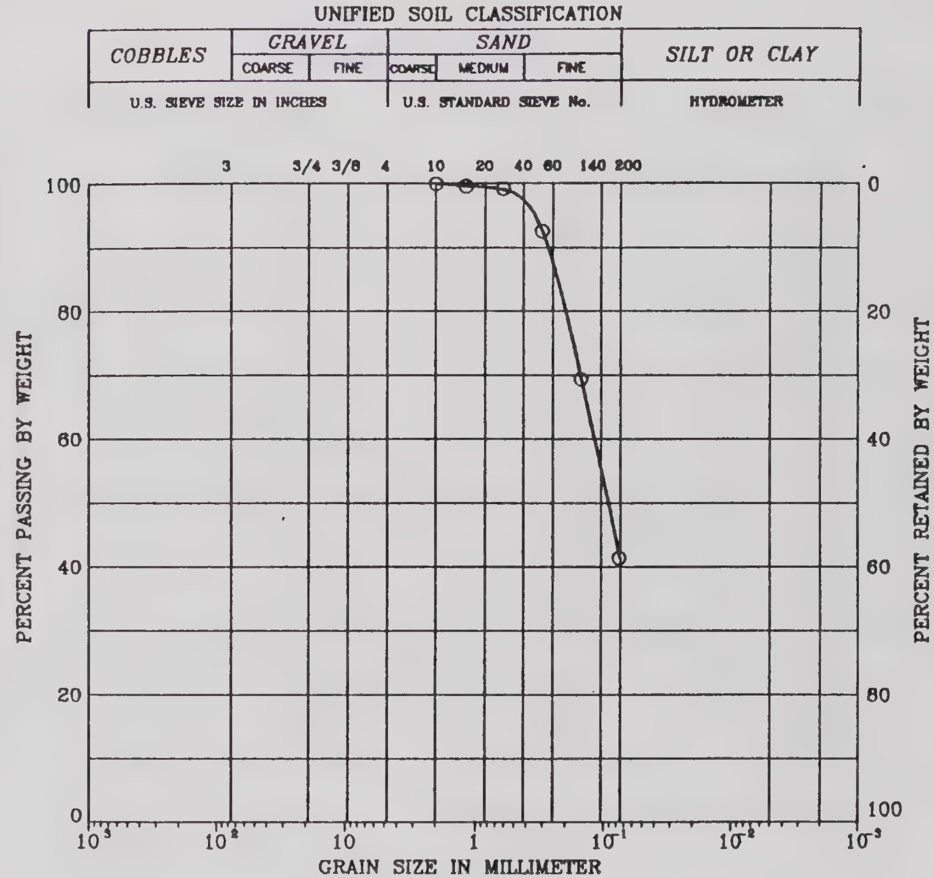
GRAIN SIZE DISTRIBUTION



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	B4-5-1	23.0			Dark olive gray poorly-graded SAND (SP)

Remark :

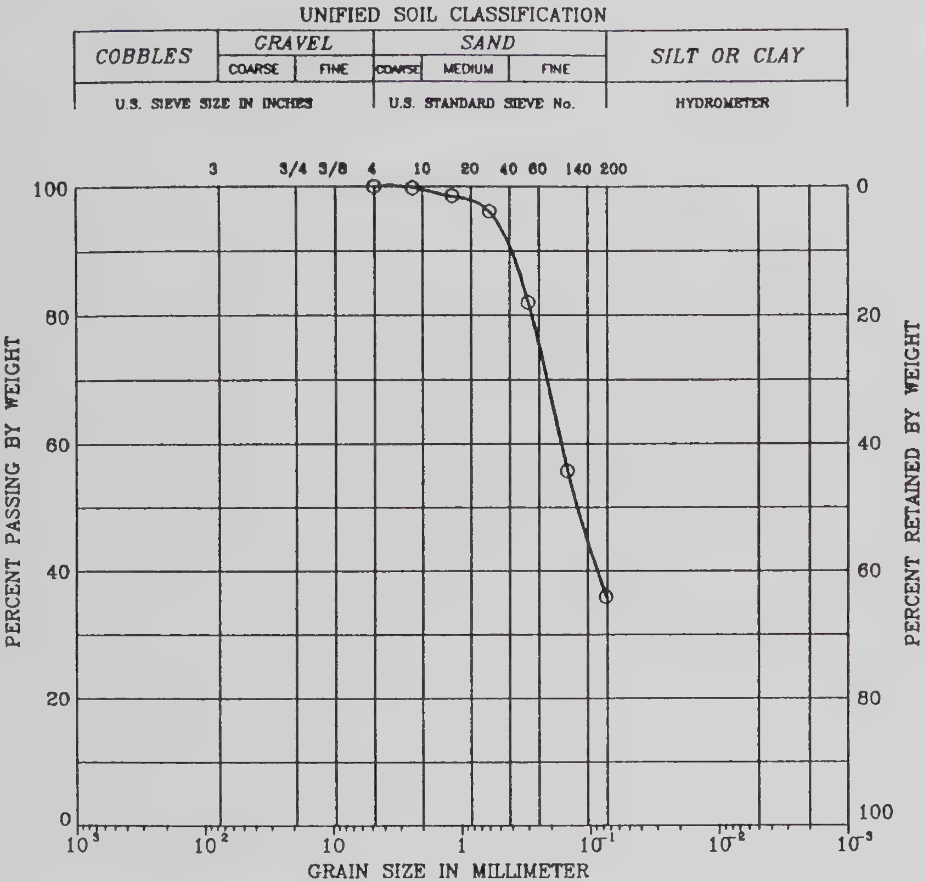
C6-2280-C1	
Earth Systems	GRAIN SIZE DISTRIBUTION



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	B10-4-1	18.5			Olive brown silty SAND (SM)

Remark :

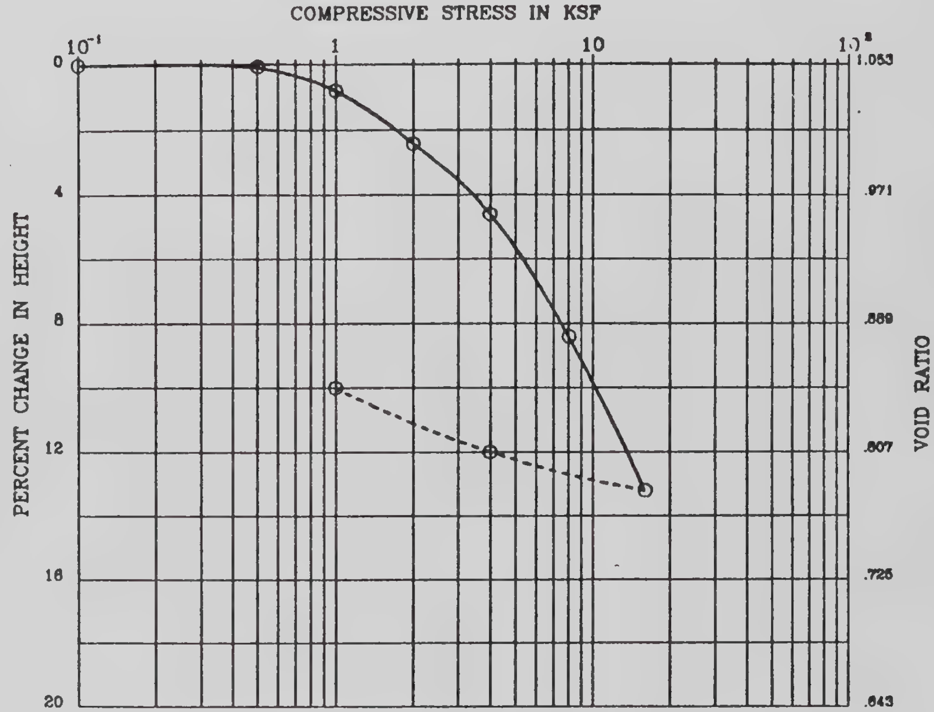
C6-2280-C1	
Earth Systems	GRAIN SIZE DISTRIBUTION



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	B10-5-1				Very dark gray silty SAND w/clay (SM)

Remark : V.dk gray silty SAND w/clay (SM)

C6-2280-C1	
Earth Systems	GRAIN SIZE DISTRIBUTION



BORING : B4-6-2
DEPTH (ft) : 28.5
SPEC. GRAVITY : 2.79

DESCRIPTION : very dark gray fat CLAY (CH)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	36.6	84.9	97	1.053
FINAL	30.3	94.3	100	.848

Remark : Moist, medimum stiff

C6-2280-C1	
Earth Systems	CONSOLIDATION TEST

APPENDIX C

TECHNICAL REPORTS

SAN JOSE ARENA FACILITY

SITE C

SAN JOSE, CALIFORNIA

APPENDIX C-1

TRAFFIC AND CIRCULATION ANALYSIS

BARTON-ASCHMAN ASSOCIATES, INCORPORATED

SAN JOSE, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

SAN JOSE ARENA FACILITY
TRAFFIC & PARKING
IMPACT STUDY
FOR SITE "C"

Prepared For:

THE REDEVELOPMENT AGENCY OF
THE CITY OF SAN JOSE

Prepared By:

Barton–Aschman Associates, Inc.
July 1987

SAN JOSE ARENA FACILITY

TRAFFIC & PARKING

IMPACT STUDY

FOR SITE C

Prepared For:

The Redevelopment Agency of
The City of San Jose

Prepared By:

Barton-Aschman Associates, Inc.

July 1987

23401515/TS/A Site C:87362

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.

INTRODUCTION

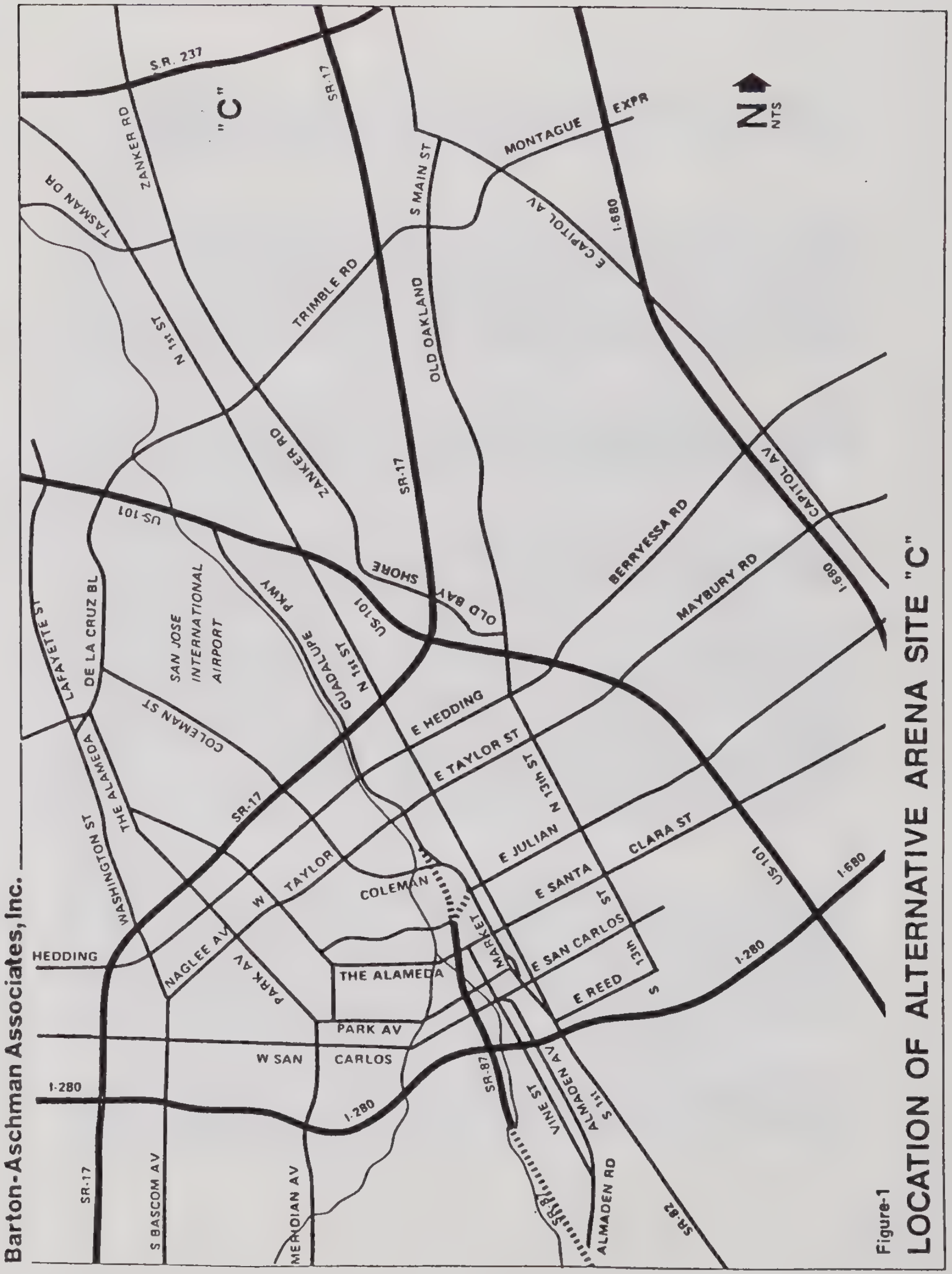
The City of San Jose is considering the construction of an arena facility for indoor sporting events, entertainment, ice shows and concerts, and large meetings. The purpose of this report is to analyze the anticipated traffic, parking, and neighborhood impacts that would be created by a general-purpose indoor arena facility.

The proposed site is located in northern San Jose, east of Zanker Road and just south of the Santa Clara County Transit Agency's Bus Maintenance Facility (see Figure 1).

For a comprehensive analysis of the potential impacts such a facility could have on the existing transportation infrastructure, three different time scenarios and two different seating capacities were considered in this study. The different time scenarios focused on weekday evening events. One scenario investigated the impact of the arena on the PM peak hour commute traffic conditions. The other two dealt with the traffic conditions before the start and after the end of the arena events.

Two different attendance levels were considered in this study. While most of the events are expected to draw a maximum attendance level of 17,500 persons, it is anticipated that an attendance level of 20,000 persons may occur a few times a year.

The following chapters are sections on parking, traffic, and neighborhood impacts. Each chapter discusses the existing conditions, outlines the assumptions used for the analysis and presents the findings and recommendations. Conclusions drawn from this study are provided in the last chapter of this report.



Barton-Aschman Associates, Inc.

Figure-1

LOCATION OF ALTERNATIVE ARENA SITE "C"

2.
PARKING NEEDS AND SUPPLY

The parking demand characteristics of arenas vary greatly because of the differing type, attendance levels, and time of events. Also, the parking needs for arena events are influenced by the mode of arrival, the vehicle occupancy ratio, and the average and peak attendance levels.

The proposed arena on Site C is planned to accommodate different types of events at various hours of the day and night. Each type of event would generate different parking demands. Broad categories of events would include professional sports, college sports, family shows, concerts, and community/convention functions.

This chapter summarizes the existing parking conditions, provides forecasts of parking demand with the arena, and discusses the provision of parking to serve the arena patron parking needs.

2.1 Existing Parking Inventory & Usage

Currently, there is a bus maintenance facility at the north-end of the proposed Site C location. There are about 250 parking spaces provided for the employees of the bus maintenance facility. Most of the parcels surrounding the site are vacant. The only available parking supply in the vicinity of Site C is beyond the range of acceptable walking distances.

At the maintenance facility employees work in three shifts. The parking demand is distributed over the twenty-four hour day. The day shift parking demand for the employees was observed to be 200 spaces. The evening shift has 65 spaces occupied and the night shift parking demand has 35 spaces occupied.

2.2 Arena Parking Demand

The parking demand for an arena at Site C will depend on the mode of arrival, vehicle occupancy of the arena patrons, the starting and ending time of the arena events, and the size of the anticipated arena facility. Following is a brief discussion of each of the elements as they apply to the site.

Travel Mode

Use of the private automobile as an arrival mode to the arena is largely dependent on the cost of parking, the available parking supply and the existence of other convenient transportation alternatives for the arena patrons.

Due to the suburban location of the site, currently only one bus route (Route 82) operates in the vicinity of the proposed site on Zanker Road. Unless special bus service is instituted for the arena patrons, it is not likely that the current service will expand due to relatively little demand for transit service.

However, it is anticipated that charter buses would be used by the arena patrons. Also, the use of express buses to the arena events could be considered provided that the demand warrants such a service. It is estimated that about 2% of the arena patrons would be using various forms of bus service.

Vehicle Occupancy

Vehicle occupancy for an arena varies by the type of event. For example, family shows, which attract many youngsters and senior citizens, normally have much higher person-per-car ratios than sporting or other events. In the past decade, the professional basketball games at the Oakland Coliseum averaged from 2.90 to 3.15 persons per vehicle. During the same period at the Coliseum, family shows ranged from 4.5 to 5.0 persons per car and concerts typically ranged between 3.5 and 4.0 persons per vehicle.

The firm of Coliseum Consultants is a member of the team for the study of alternative arena sites in San Jose. Based on their experience, the consultants recommend 3.0 persons per car as the average vehicle occupancy for this study. On the basis of this recommendation, a vehicle occupancy factor of 3.0 was adopted.

Peak Attendance Period

The attraction of people to events held at the proposed arena will depend largely on the patrons available leisure time. As a result, the majority of events will be held during evenings and on weekends to avoid conflicts with normal working hours.

Experience with other indoor arenas around the country has shown that most regularly scheduled professional sporting events are held on weekends and during weekday evenings. Certain other special events may have weekday show times although peak attendance usually occurs during evenings and on weekends. For this analysis, the parking demand was estimated for two time periods. The parking demand for the evening events was estimated based on the full capacity attendance for major events. The parking demand for afternoon events, consisting of family shows such as circuses and ice shows, was estimated for an average attendance level based on the experiences of other similar arena facilities around the country.

Arena Size

The proposed arena would be designed to host more than one type of attraction. Similar arenas are used for sporting events such as NBA basketball, ice hockey, professional boxing/wrestling, and tennis tournaments. In addition to the sporting events the arena would also host events not related to sports, for example concerts, ice shows, and circuses. Planning principles dictate that for an arena facility intended for multiple uses, the regular event generating the largest parking demand should be the basis for determining parking provisions. For example, NBA basketball is considered to be an event that would occur with regularity.

The other important factor that should be considered in planning parking for an arena is the maximum seating capacity. In this study, two alternative seating capacities are being analyzed. The first alternative would provide 17,500 seats; the second alternative would provide 20,000 seats.

Parking Demand Estimates

The parking demand estimates for the 17,500 and 20,000 seats arena alternatives for evening full capacity attendance are shown in Table 1. The 17,500 seat arena would need 5,600 parking spaces either at the arena site or within a reasonable walking distance. Similarly, the 20,000 seat arena would require 6,400 spaces. Weekday afternoon matinee events would occur about 20 times a year. The average attendance for these afternoon events would be between 10,000 and 12,000 persons.[1] The matinee events would require 2,610 parking spaces.

TABLE 1
ARENA PATRONS MODE OF ARRIVAL AND PARKING DEMAND — SITE C

Attendance	Bus Users (Persons)	Car Users (Persons)	Required No of Parking Spaces
Evening and Weekend Events			
17,500	350	17,150	5,720
20,000	400	19,600	6,530
Weekday Afternoon Event			
11,000	550	10,450	2,610

Due to the family orientation of matinee shows usually large family groups attend these events and arrive together in automobiles or vans. The vehicle occupancy for automobiles used to travel to such functions is also reported to be higher than average. A vehicle occupancy of 4.0 persons per automobile is not uncommon. The use of public transit system is very low. However, the use of charter buses to carry school children and senior citizens is very extensive. The estimated number of parking spaces required for matinee events is based on an average attendance of 11,000 persons per event, an average vehicle occupancy of 4.0 persons per car with 5% arrivals by charter buses.

2.3 Parking Supply

The parking demand for an arena can be satisfied in a number of different ways depending on the day and the time the events are held. Some of the methods to satisfy the arena parking demand include the following:

1) Provide parking on the site.

1 Coliseum Consultants Letter of June 10, 1987

2) Use the existing surrounding parking supply that is (a) within an acceptable walking distance and (b) having non-concurrent parking demand.

3) Provide a remote parking area with a shuttle bus operation to the arena.

To satisfy the parking demand for Site C the first of the three strategies was adopted because there is no large supply of parking available within a reasonable walking distance from the arena site, and there is sufficient available vacant land to provide the necessary parking.

Therefore, it will be necessary to provide 5,720 spaces for the 17,500 attendance level and 6,530 spaces for the 20,000 attendance level at the arena site (see Table 1).

2.4 Proposed Parking Strategy

Due to the site's suburban location and because there is no other parking supply in the vicinity, it is recommended that for the 17,500 attendance level there should be 5,600 spaces and for the 20,000 attendance level 6,400 parking spaces should be constructed. Either one of these numbers of spaces will be more than sufficient to accommodate the parking needs for the weekday afternoon events.

3.

TRAFFIC IMPACT ANALYSIS

The objective of this analysis is to determine how the transportation system will be affected by the arena project. For a complete traffic analysis of the site under consideration, three different time scenarios were considered for each of two different seating capacities. The three scenarios are:

1. Weekday PM Peak Hour Analysis (between 4:00 and 6:00 PM) with an arena event starting time of 6:00 PM.

2. Weekday Evening Peak Hour Analysis (between 6:00 and 8:00 PM) with an arena event starting time of 7:30 PM.

3. Weekday Late Evening Peak Hour Analysis (between 10:00 PM and 12:00 Midnight) with an arena event ending time of 10:30 PM.

The two different seating capacities considered are 17,500 seats and 20,000 seats.

For matinee events between 1:30 and 4:00 PM, a traffic analysis was not conducted because the attendance at these events is projected to be only 11,000 persons, which is not as critical as the 17,500 or 20,000 persons attendance level for the weekday PM peak hour.

The different scenarios were evaluated for existing, Year 1991, and Year 2000 traffic conditions.

3.1 Existing Conditions

The City of San Jose selected four critical intersections around the proposed Site C for traffic impact analysis. These locations are as follows:

1. Zanker Road and S.R. 237
2. First Street and S.R. 237
3. Zanker Road and Montague Expressway
4. First Street and Montague Expressway

Descriptions of the tasks performed and analyses conducted for evaluating existing conditions are provided in the following sections.

Data Collection

Data collected for similar arena facilities in other areas indicated that about 93% of the arena patrons arrive during the hour before the start of the event. For events starting at 7:30 PM, approximately 4% would arrive during the PM peak hour between 5 PM and 6 PM and the remaining 3% would arrive at other times.

The departure pattern varies more so by type of event. For example, it has been noted that for basketball events, an estimated 48% of the patrons leave before the

end of the event, while for entertainment events, only 7% were found to have departed the surveyed site prior to the conclusion of the event.

Approximately two or three times a year, arena events may begin as early as 6:00 PM. These are events which would be broadcasted to audiences nationwide.[2] For these events the peak hour of arena patron arrival would occur during the PM peak period. However, the starting time for most arena events is expected to be 7:30 PM with the peak hour for arena patron arrival occurring between 6:30 and 7:30 PM. Likewise, an event with an ending time around 10:30 PM would result in a peak hour for arena patron departure of around 10:30 to 11:30 PM.

The traffic counts for the PM peak hour were obtained from the City of San Jose. For intersection locations where counts were taken during the previous years, an annual growth factor of 3.6 percent was applied to reflect existing (1987) traffic conditions. The peak hour counts for the remaining time periods were obtained from recent manual turning movement counts conducted by Barton-Aschman Associates, Inc. Traffic counts were taken during the evening period between 6:30 and 8:30 PM and the late evening period between 10:00 PM and Midnight.

Intersection Operation

The traffic conditions at an intersection can be described in the terms of Level of Service (LOS). Level of Service is a qualitative description of an intersection's operation based on the amount of traffic, conflicting traffic movements, delays and congestion. Levels of Service can range from A, representing free flow conditions, to F, representing jammed conditions. Generally, the Level of Service is derived from the ratio of traffic volumes and available capacity shown as V/C ratios. The various levels of service, their descriptions and range of V/C ratios are shown in Table 2.

A signalized intersection's level of service can be calculated with a number of different methods. The City of San Jose has adopted its own method which is based on critical traffic movements. In this method the volume of cars completing the turning movements that dictate the operation of the intersection are added together. The sum is divided by the capacity of the movements, and a volume to capacity ratio is obtained. The volume-to-capacity ratio is correlated to a level of service described in Table 2.

Existing Intersection Level of Service:

The results of the level of service calculations performed for the four intersections for the different time periods are presented in Table 3. In general, the City of San Jose considers any intersection operating below Level of Service D, as unacceptable. The results of the intersection level of service analyses indicated that for the PM peak hour, three intersections operate at Level of Service F. They are:

1. Zanker and S.R. 237
2. First and S.R. 237
3. First and Montague

---

[2] Telephone Conversation with Mr. Bill Cunningham, July 16, 1987.

TABLE 2
INTERSECTION LEVEL OF SERVICE DEFINITIONS

Level of Service	Interpretation	V/C Ratio
A, B	Uncongested operations; all queues clear in a single signal cycle.	Less Than .7
C	Light congestion; occasional backups on critical approaches.	.700 - .799
D	Significant congestion on critical approaches but intersection functional. Cars required to wait through more than one cycle during short peaks. No long-standing queues formed.	.800 - .899
E	Severe congestion with some long-standing queues on critical approaches. Blockage of intersection may occur if traffic signal does not provide for protected turning movements. Traffic queue may block nearby intersection(s) upstream of critical approach(es).	.900 - .999
F	Total breakdown, stop-and-go operation.	1.0 And Greater

TABLE 3
EXISTING INTERSECTION LEVELS OF SERVICE

Intersection	Wkdy PM		Wkdy Eve.		Wkdy Late Eve.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C
Zanker & S.R. 237	F	1.008	C	.772	A	.398
First & S.R. 237	F	1.020	B	.622	A	.250
Zanker & Montague	A	.585	A	.361	A	.104
First & Montague	F	1.012	A	.461	A	.152

/a/ LOS = Level of Service

/b/ V/C = Volume to Capacity Ratio

Hourly Traffic Variation

Traffic volumes on the street system vary over the twenty-four hour period. During the weekday AM and PM peak periods there are more vehicles on the roadways than during the mid-day period. At night, traffic volumes on most streets are relatively low.

Different types of roadway facilities have different hourly variations throughout the day. For example, major arterials carrying heavy commuter traffic have a different pattern from streets serving retail areas.

In order to determine the travel pattern for the area in the vicinity of Site C, 24-hour counts were conducted at the following locations:

1. Montague west of Zanker
2. Zanker south of Route 237

The machine counts were taken in May 1987. The weekday traffic volumes measured on a typical weekday are given in Table 4. The hourly totals for these counts were plotted in graphical form to determine the hourly travel pattern, the traffic volumes during peak travel times, and the off-peak travel characteristics. The hourly variations for both locations are shown in Figures 2 and 3.

The count data show that during the weekdays and PM peak hour traffic volumes equal or exceed the AM peak hour volumes. Generally, the traffic volumes drop sharply after 6:00 PM.

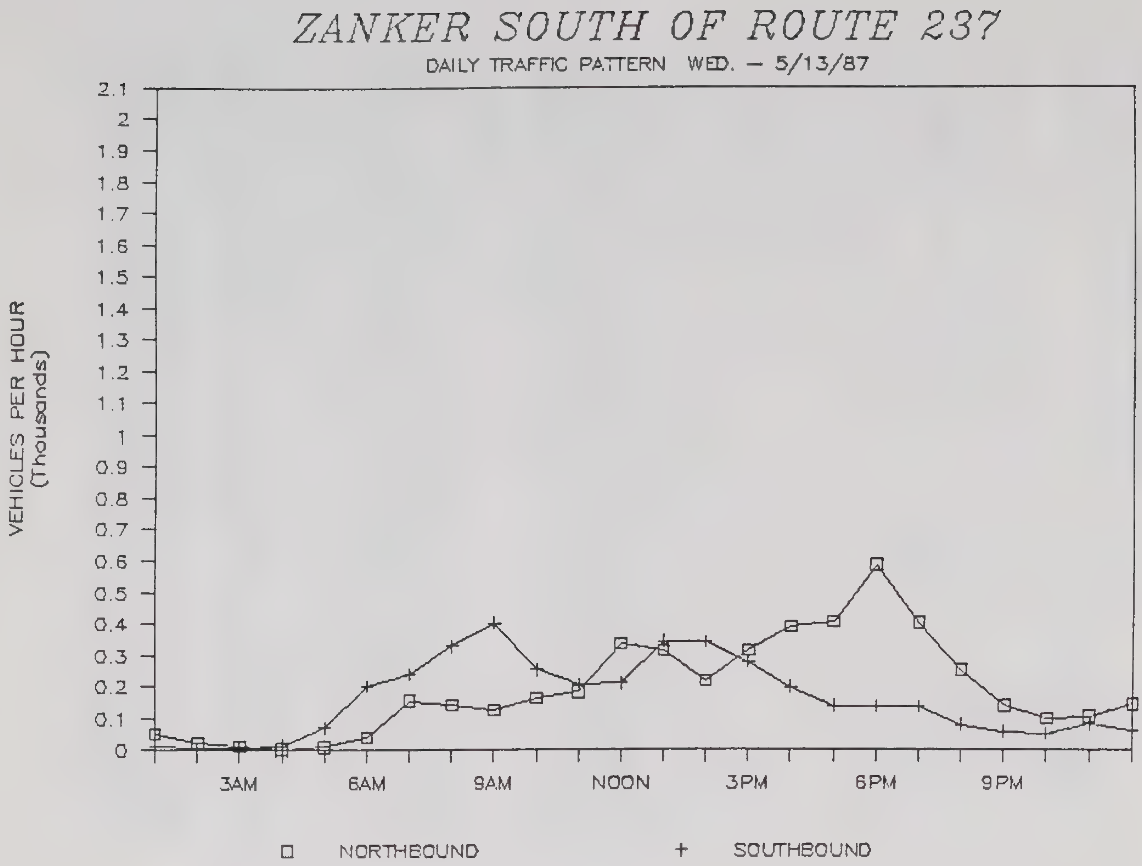


Figure-3

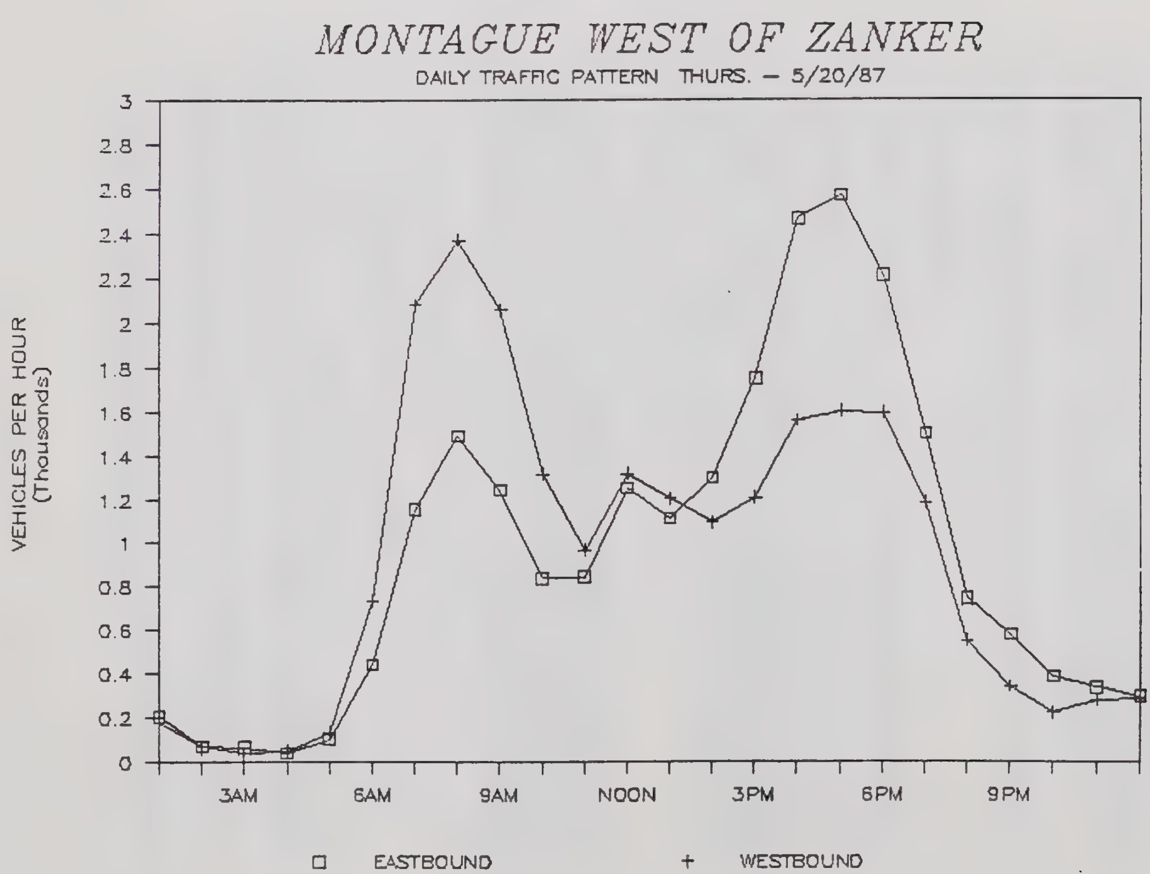


Figure-2

TABLE 4
SUMMARY OF 24-HOUR MACHINE COUNTS

Count Location		24-Hour Weekday Traffic Volumes
1. Montague Expressway west of Zanker	EB/a/	23,008
	WB/b/	22,423
2. Zanker Road south of S.R. 237	NB/c/	4,622
	SB/d/	3,859

/a/ EB = Eastbound

/b/ WB = Westbound

/c/ NB = Northbound

/d/ SB = Southbound

It should be noted that these graphs clearly reflect the character of the street and the function that it performs. For example Montague Expressway carries a significant amount of commuter travel on weekdays during the AM and PM peak periods. These commute patterns are reflected in the high peaks on the graph. However, Zanker Road carry lower volumes and less commuter trips. The pattern in this case is flatter and do not show the high peaks.

Transit Services

Currently, no mass transit improvements are planned for the area in the vicinity of Site C. However, studies are underway to investigate a mass transit connection between Fremont and the South Bay. A number of BART and Light Rail options are being studied. It is possible that a light rail connection could be constructed from North First Street along Tasman Drive into Milpitas. If this happens, Site C will benefit from such a service. For this study, no mass transit service was assumed.

Road System Improvements

Major transportation system improvements are planned for the area in the vicinity of Site C. The three facilities targeted for future improvements, that would serve Site C include Route 237, Zanker Road, and Tasman Drive.

Route 237 is currently an expressway with at-grade signalized intersections on North First Street and Zanker Road. Under the Measure A Program, Route 237 is planned to be upgraded to a full freeway facility. However, the status of this improvement is not certain. The completion date, at this time, is not known. For this study, this improvement was not assumed to have been completed for the Year 1991 analyses.

Zanker Road in the vicinity of Site C is planned to be a six-lane arterial facility. This roadway is funded for construction of the median and 1 lane on each side from River Oaks to Route 237 in the 1987-1988 Capital Budget. Developers would be responsible for completion to the ultimate six lane width. The schedule for these activities is currently on an as-needed basis to match the development of adjacent properties.

Tasman Drive will be extended across the Guadalupe River to the City of Santa Clara. However, this project is not scheduled in the Capital Improvement Program. This extension would have minimal traffic impact on Site C.

3.2 1991 Base Conditions

It is anticipated that 1991 is a year for the opening of the proposed arena development. Therefore, the traffic analysis was completed for Year 1991 conditions.

Intersection Operation

For the three scenarios studied, existing traffic volumes at the four critical intersections were factored by an annual growth rate of 3.6 percent to Year 1991. This growth rate reflects the annual increase in the regional background traffic anticipated between now and 1991. Also, the anticipated traffic volumes from future projects in the site vicinity which have been approved were added to the factored traffic volumes. This provided Year 1991 base traffic volumes.

Year 1991 (Base Conditions) Level of Service:

The results of the level of service calculations performed for Year 1991 base traffic conditions are summarized in Table 5. These traffic volumes do not include any project traffic. The purpose of analyzing Year 1991 base conditions is to determine the operating level of the studied intersections prior to the addition of the arena-generated traffic for Year 1991. The number of intersections which would operate under unacceptable conditions for each of the time scenarios analyzed are provided below:

— Weekday PM peak hour: 3 intersections

— Weekday Evening peak hour: 2 intersections

— Weekday Late Evening peak hour: None

The results indicate that the three intersections which are operating under unacceptable conditions during the PM peak hour would continue to have LOS F operating conditions during the PM peak hour.

The two intersections on S.R. 237 would also be operating under unacceptable conditions during the evening peak hour.

These conclusions clearly indicates that with or without the arena development on Site C, major intersection improvements would be necessary for the two S.R. 237 intersections and the intersection of First and Montague.

TABLE 5
1991 BASE CONDITION INTERSECTION LEVELS OF SERVICE

Intersection	Wkdy PM		Wkdy Eve.		Wkdy Late Eve.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C
Zanker & S.R. 237	F	1.513	F	1.209	D	.873
First & S.R. 237	F	1.637	F	1.072	A	.408
Zanker & Montague	D	.875	A	.513	A	.144
First & Montague	F	1.460	C	.755	A	.259

/a/ LOS = Level of Service

/b/ V/C = Volume to Capacity Ratio

3.3 Year 1991 Base Plus Project Conditions

In this study analyses were conducted for two different seating capacities: 17,500 seats and 20,000 seats. For both cases, maximum attendance was assumed.

Trip Generation

The arena trip generation estimates for each of the two seating capacities are given in Table 6. These numbers are based on the following assumptions:

- Estimated Transit use: 2% by buses; no mass transit service assumed.
- An average of 3.0 persons per car.
- The arena events will start at 7:30 PM.
- About 4% of the patrons will arrive during the PM peak hour.
- An estimated 93% will arrive to the arena site during the hour immediately before the start of the event.
- An estimated 93% of the patrons will leave the arena during the hour immediately after the event.

The traffic analysis is based on the assumption that 98% of the arena patrons would arrive by car.

Automobile Trip Distribution and Assignment

Year 1995 projected population statistics for the South Bay area were used to determine the market area for the arena site. The economic consultants[3] provided the projected population for each geographic segment of the market area. The population

TABLE 6
TRIP GENERATION FOR ARENA

Site	Average Peak Attendance	Transit (Person Trips)	Automobile (Vehicle Trips)
C	17,500	350	5,720
C	20,000	400	6,535

information was extracted from the projections produced by the Association of Bay Area Governments. The automobile trip distribution was based on the percentages shown on Figure 4, which gives the percentage of the total arena trips estimated to use each of the regional facilities. The majority of the arena patrons is expected to use regional freeway facilities for obtaining access to the site area.

The estimated automobile trips were distributed and assigned to the regional and local roadways approaching the proposed arena site. The resulting PM peak, evening peak, and late evening peak hour traffic assignments were used to determine the traffic impact of the arena project.

Intersection Operation

Year 1991 (with Project) Level of Service:

The intersection level of service calculation results for both seating capacities (i.e. 17,500 seats and 20,000 seats) with maximum attendance are presented in Tables 7 and 8. The number of intersections that would operate under unacceptable conditions for both attendance levels are given below:

- Weekday PM peak hour: 4 intersections
- Weekday Evening peak hour: 2 intersection
- Weekday Late Evening peak hour: None (For 17,500 persons attendance level)
  One (For 20,000 persons attendance level)

However, when these results are compared with the results from Year 1991 base conditions (without the arena traffic), it is observed that three intersections would already operate under unacceptable conditions during the PM peak hour and two intersections during the evening peak hours.

According to the City of San Jose policy, the traffic impact of a project at an intersection is considered significant and therefore will require mitigation(s) if either one of two following conditions occur:

1. The level of service of an intersection deteriorates from an acceptable level (LOS A, B, C, or D) to an unacceptable level (LOS E or F) after the addition of the project traffic, or

3 Economics Research Associates

Barton-Aschman Associates, Inc.

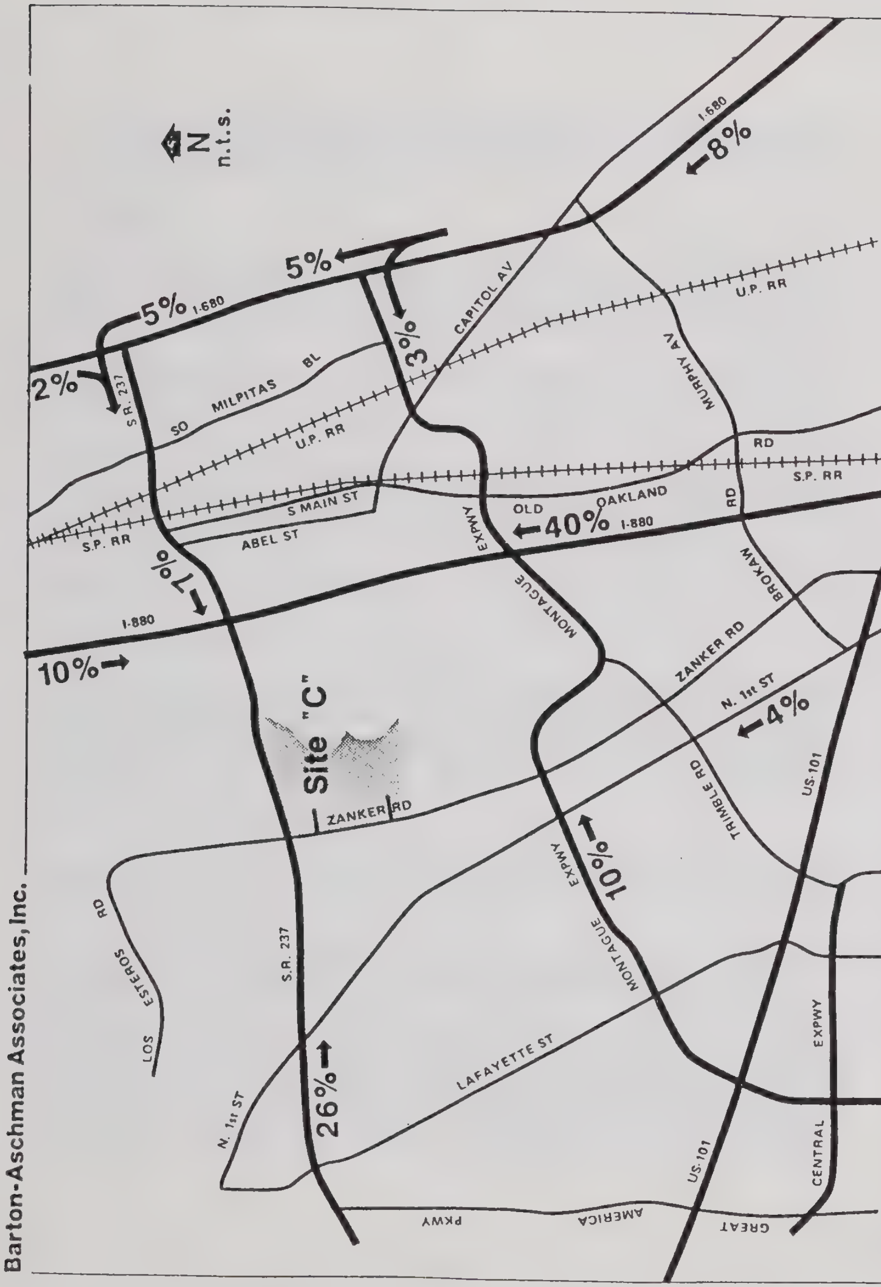


Figure-4
DIRECTIONS OF APPROACH- SITE "C"

TABLE 7
1991 WITH PROJECT (CAPACITY: 17,500 PERSONS) INTERSECTION LEVELS OF SERVICE

Intersection	Wkdy PM		Wkdy Eve.		Wkdy Late Eve.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C
Zanker & S.R. 237	F	2.000+	F	2.000+	D	.873
First & S.R. 237	F	1.715	F	1.097	C	.702
Zanker & Montague	F	1.149	B	.619	A	.549
First & Montague	F	1.533	D	.861	A	.367

/a/ LOS = Level of Service

/b/ V/C = Volume to Capacity Ratio

TABLE 8
1991 WITH PROJECT (CAPACITY: 20,000 PERSONS) INTERSECTIONS LEVELS OF SERVICE

Intersection	Wkdy PM		Wkdy Eve.		Wkdy Late Eve.	
	LOS/a/	V/C/b/	LOS	V/C	LOS	V/C
Zanker & S.R. 237	F	2.000+	F	2.000+	E	.936
First & S.R. 237	F	1.722	F	1.129	C	.742
Zanker & Montague	F	1.192	B	.657	B	.607
First & Montague	F	1.543	D	.877	A	.386

/a/ LOS = Level of Service

/b/ V/C = Volume to Capacity Ratio

2. For an intersection operating at an unacceptable level of service prior to the addition of the project traffic, the proposed project increases the critical base condition traffic volumes by 1% or more.

PM Peak Hour

By the City of San Jose's Level of Service Policy, all four intersections would be significantly impacted during the PM peak hour for an arena event with a start time of 6:00 PM. It is worth noting that with or without the arena development at Site C, three of these intersections would have serious operational problems with long queues and delays.

Potential mitigation measures to improve the intersection operations are discussed in Section 3.6.

Evening Peak Hour

The S.R. 237 intersections would also have operational problems during the evenings. The traffic associated with arena events would cause the operations of these intersections to deteriorate even more, especially at Zanker and S.R. 237.

Potential mitigation measures to improve the intersection operations are discussed in Section 3.6.

Late Evening Peak Hour

Due to the relatively low base traffic volumes on the roadways during this time period the operations of three intersections included in this traffic analysis would be above the minimum acceptable standards, even with 93% of the arena traffic leaving the site within the hour after the end of the event. The only exception occurs at the Zanker and S.R. 237 intersection. For the 20,000 persons attendance level this intersection would operate at LOS E (with V/C ratio = .936).

3.4 Year 2000 Base Conditions

The traffic impact analysis for the Year 2000 was conducted to determine the long term impact of the arena project. An analysis of this type requires a reliable long range forecast of background traffic.

The City of San Jose has developed and calibrated a travel demand model for the Year 2000. This model was used for forecasting the PM peak hour traffic volumes for the city streets. This model is known as the HORIZON 2000 TRANPLAN model.

This model is based on the TRANPLAN computer software package, which is commonly used for traffic simulation studies for large urban areas such as the City of San Jose. The City's model is a sophisticated analytical tool with more than 600 traffic analysis zones and thousands of network links. It generates, distributes and assigns nearly 500,000 all purpose trips to the road system network for the PM peak hour. During the assignment process this model accounts for traffic congestion by

assigning trips so as to minimize travel time on the road network, but also takes into consideration the available road system capacity. Major planning assumptions built into the model for the Year 2000 include the following:

- o Calibration of model using Year 1980 census data.
- o Year 2000 data generally matched the ABAG 2005 projections.
- o Full built-out of North San Jose by Year 2000.
- o Completion of the following transportation system projects.
  - — Construction of Route 87 as a freeway from south San Jose to north of Taylor Street.
  - — Expansion of I-280 to 8 lanes from I-880 to Magdalena Avenue.
  - — Widening of I-880 to 6 lanes north of U.S. 101.
  - — Modification of Route 237 to provide 8 lanes (6 lanes plus 2 auxiliary lanes).
- o Increased diversion to transit and carpools, with an expanded countywide HOV lane program, which includes I-280, U.S. 101 and Route 237, San Tomas Expressway, Capital Expressway, Montague Expressway, Lawrence Expressway, and Central Expressway.

The city's traffic model, described above, was utilized for estimating the Year 2000 base traffic volumes in the vicinity of Site C.

Different factors were applied to the PM peak hour traffic volumes produced by the city's traffic model for projections of traffic volumes during the other time periods under study. These peak hour factors were developed from the twenty-four hour machine counts taken along various roadway facilities in the project area.

Intersection Operation

Year 2000 (Base Condition) Level of Service:

The projected operation of the intersections in the vicinity of the site is described in Table 9.

The number of intersections that would operate under unacceptable conditions for each of the time scenarios analyzed are as follows:

- — Weekday PM peak hour: 2 intersections
- — Weekday Evening peak hour: None
- — Weekday Late Evening peak hour: None

By Year 2000 even without the arena project, the two intersections on Montague are projected to operate at unacceptable levels of service during the PM peak hour.

TABLE 9
YEAR 2000 BASE CONDITION INTERSECTION LEVELS OF SERVICE

Intersection	Wkdy PM LOS/a/	Wkdy PM V/C/b/	Wkdy Eve. LOS	Wkdy Eve. V/C	Wkdy Late Eve. LOS	Wkdy Late Eve. V/C
Zanker & S.R. 237	N.A./c/		N.A.		N.A.	
First & S.R. 237	N.A.		N.A.		N.A.	
Zanker & Montague	E	.919	B	.667	A	.249
First & Montague	E	.938	B	.652	A	.229

/a/ LOS = Level of Service
/b/ V/C = Volume to Capacity Ratio
/c/ N.A. = Not Applicable

3.5 Year 2000 Base Plus Project Conditions

The traffic impacts of the arena project on Year 2000 base traffic conditions were determine for the two attendance levels studied.

Intersection Operation

Year 2000 (With Project) Level of Service:

The intersection level of service calculation results for both seating capacities (i.e. 17,500 seats and 20,000 seats) with maximum attendance are presented in Tables 10 and 11.

The number of intersections which would operate under unacceptable conditions are as follows:

- Weekday PM peak hour: 2 intersections
- Weekday Evening peak hour: None
- Weekday Late Evening peak hour: None

When these results are compared with the results from Year 2000 base conditions (without the arena project), it is observed that the two Montague Expressway intersections would already operate under unacceptable conditions during the PM peak hour prior to the addition of the arena traffic through these intersections. However, the increases in the critical base volumes are considered significant by the City of San Jose's Level of Service Policy. Therefore, mitigations would be required at these intersections.

TABLE 10
2000 WITH PROJECT (CAPACITY: 17,500 PERSONS) INTERSECTION
LEVELS OF SERVICE

Intersection	Wkdy PM LOS/a/	Wkdy PM V/C/b/	Wkdy Eve. LOS	Wkdy Eve. V/C	Wkdy Late Eve. LOS	Wkdy Late Eve. V/C
Zanker & S.R. 237	N.A./c/		N.A.		N.A.	
First & S.R. 237	N.A.		N.A.		N.A.	
Zanker & Montague	F	1.153	D	.847	B	.638
First & Montague	F	1.053	C	.776	A	.315

/a/ LOS = Level of Service

/b/ V/C = Volume to Capacity Ratio

/c/ N.A. = Not Applicable

TABLE 11
2000 WITH PROJECT (CAPACITY: 20,000 PERSONS) INTERSECTION
LEVELS OF SERVICE

Intersection	Wkdy PM LOS/a/	Wkdy PM V/C/b/	Wkdy Eve. LOS	Wkdy Eve. V/C	Wkdy Late Eve. LOS	Wkdy Late Eve. V/C
Zanker & S.R. 237	N.A./c/		N.A.		N.A.	
First & S.R. 237	N.A.		N.A.		N.A.	
Zanker & Montague	F	1.202	D	.893	B	.694
First & Montague	F	1.071	C	.794	A	.336

/a/ LOS = Level of Service

/b/ V/C = Volume to Capacity Ratio

/c/ N.A. = Not Applicable

3.6 Transportation Mitigations

The required transportation-related improvements for both Year 1991 and Year 2000 are outlined below. The intersections which could not be mitigated due to physical constraints are indicated as well.

Year 1991

PM Peak Hour:

1. Zanker and S.R. 237 and First and S.R. 237 Intersections

   As indicated earlier, S.R. 237 is currently an expressway with at-grade signalized intersections at these two intersections and several others. Under the Measure A Program, S.R. 237 is planned to be upgraded to a full freeway facility with interchanges planned at these two locations. Since the time frame for this improvement is not certain, no interchanges were assumed in this study. However, the LOS calculations have indicated that without the interchanges both intersections would have severe operational problems during both the PM and evening peak hours by Year 1991.

   It is recommended that this improvement be a priority item under the Measure A Program, whether or not the arena is built on Site C. An arena at this location would require improved operations through these two intersections. Using the conceptual plans available to-date, the planned interchange ramp and lane configurations would adequately accommodate the arena traffic without extended queues onto Route 237.

2. First and Montague Intersection

   Under existing conditions, First and Montague crosses at an at-grade signalized intersection. By Year 1991, this intersection is projected to have LOS F operating conditions (with V/C = 1.460). It is recommended that grade-separation for the through movement on Montague Expressway be considered.

3. Zanker Road, between S.R. 237 and Montague Expressway, would need to be widened to provide three northbound and three southbound through lanes. At the two northern site access driveways, two exclusive left turn lanes would be required to serve the inbound arena traffic. At the southern access driveway, one southbound left turn lane (on the north approach) and an additional right-turn lane (on the south approach) would be required.

4. It is assumed that all the signalized intersections would be operating under optimal signal phasing plans for Year 1991 and Year 2000.

Evening Peak Hour:

1. Zanker and S.R. 237 and First and S.R. 237 Intersections

   The improvements suggested above would also improve the operation of these two intersections during the evening peak hour when the inbound arena traffic is at its highest.

Year 2000

No additional improvements have been identified for Year 2000 conditions.

Transit Service Improvements

In addition to the mitigations discussed in the previous section, improvements in transit service to/from the site would also improve the traffic conditions on the streets and at intersections in the site vicinity. Ways to improve the transit service to/from the arena site include:

1. Provide express bus service between the Park and Ride lot locations and the arena site.

2. Run a shuttle bus service between the nearest LRT station and the arena site.

4.

NEIGHBORHOOD IMPACTS

Site C is located in an area with abundant vacant land. Three major developments in the proximity of Site C include: Santa Clara County Transit Agency's Bus Maintenance Facility, Mobile Parks West Mobile Home Park and the Agnews State Hospital (East Area).

Two types of neighborhood impacts are anticipated if the arena is located in a neighborhood area. The first impact is the use of surrounding streets for parking by arena patrons. The second impact is the infiltration of arena traffic on local streets.

Do to its location and the current development patterns neither the parking nor the traffic impacts are anticipated in the neighborhood. The Mobile Home Park has its access road connected to North First Street. Therefore, there would not be any direct traffic impact on the Mobile Home Park. Agnews State Hospital is located south of the proposed site and has its entrance and road system designed in such a way that it is easy to monitor the arena patrons if they attempt to park at the Hospital parking lots or on its street system.

In summary, under the existing development pattern, the parking and neighborhood traffic impacts associated with the arena are expected be negligible. However, as future development proceeds on the surrounding vacant lands, it will be necessary to plan and design the street system in such a way so that arena traffic cannot infiltrate the neighborhood streets.

5.

CONCLUSIONS

A summary of the recommendations presented in Chapters 2 and 3 are presented below. The basis for these recommendations are a number of conditions and assumptions which were discussed in each of the chapters. If these conditions are satisfied, then the following conclusions are valid.

5.1 Parking

Summary of Analysis

The parking demand analysis indicated that there would be a need for 5,720 spaces for a 17,500 seat arena and 6,530 spaces for a 20,000 seat facility. All of the necessary parking should be provided on-site.

5.2 Traffic

The following improvements listed below would be required to mitigate the traffic impact generated by an arena facility located on Site C for Year 1991. For Year 2000, no additional mitigations would be required.

1. Under the Measure A Program, S.R. 237 is planned to be upgraded to a full freeway facility with interchanges planned at the intersections of First Street with S.R. 237 and Zanker Road with S.R. 237. This improvement would be necessary, whether or not the arena is built on Site C.

2. Zanker Road, between S.R. 237 and Montague Expressway, would need to be widened to provide three northbound and three southbound through lanes. At the two northern site access driveways, two exclusive left turn lanes would be required to serve the inbound arena traffic. At the southern access driveway, one southbound left turn lane (on the north approach) and an additional right-turn lane (on the south approach) would be required.

3. It is recommended that grade-separation of the through movement on Montague Expressway be considered.

5.3 Neighborhood Impacts

If the arena is located on Site C, it is recommended that the future street system for the surrounding vacant lands in the vicinity of the site be planned and designed so that the arena traffic is not allowed to infiltrate onto the neighborhood street system.

APPENDIX C-2

AIR QUALITY ANALYSIS

ENVIRONMENTAL CONSULTING SERVICES

CUPERTINO, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

Environmental
Consulting
Services

Noise
Air Quality
Energy

20430H Town Center Lane
Cupertino, CA 95014
(408) 257-1045

AIR QUALITY IMPACT AND MITIGATION STUDY

SAN JOSE SPORTS ARENA PROJECT - SITE C

San Jose, CA

July 17, 1987

Submitted to

DAVID J. POWERS & ASSOCIATES

San Jose, CA

Prepared by

H. STANTON SHELLY

Principal Consultant

SAN JOSE SPORTS ARENA PROJECT - Site C

AIR QUALITY SECTION

INTRODUCTION

The air quality of a given area is not only dependent upon the amount of air pollutants emitted locally or within the air basin, but also is directly related to the weather patterns of the region. The wind speed and direction, the temperature profile of the atmosphere, and the amount of humidity and sunlight determine the fate of the emitted pollutants each day, and determine the resulting concentrations of air pollutants defining the "air quality."

I. EXISTING SETTING

A. Regional Climate.

The Bay Area climate is a Mediterranean type, characterized by mild and rainy winters, and warm and nearly dry summers. There is a high percentage of sunshine, especially in the summer after the typical morning fog burns off. The temperature, humidity, wind, and precipitation throughout the year depend entirely upon the the movements of marine air, the location and strength of the dominant Pacific high-pressure system, and the coastal temperature gradient.

During the summer the Pacific high typically sits near the California coast, pushing oncoming eastbound storm systems north through the northwest states and Canada. Subsidence of warm air aloft associated with this system creates the frequent summer atmospheric temperature inversion and stagnated conditions. (See the Appendix for definitions of commonly-used meteorological and air quality terms.) The persistent reversal of the normal atmospheric temperature lapse rate (change with temperature) may be several hundred to several thousand feet thick, effectively trapping pollutants emitted at ground level. Winds during the summer are generally light, except for late afternoon onshore flow from differential heating

between the cool ocean and the warm land mass. Average temperatures increase as distance from the Golden Gate increases. Average maximum temperatures during the summer are near 80° F. in the South Bay, and average evening minimums are near 50° F.

During the winter the Pacific high pressure system moves southward, allowing ocean-formed storms to move through the region. With the dominance of the unstable low-pressure systems during the winter, and less sunshine, conditions favoring smog formation are at a minimum. However, radiation cooling during the evening hours sometimes creates thin inversions, concentrating carbon monoxide emissions at ground level. Average maximum winter temperatures in Santa Clara County are about 60° F., and average evening lows are about 40° F.

Lying in the rain shadow of the Santa Cruz Mountains, the South Bay receives only 2/3 of the precipitation which falls upon San Francisco, and a quarter of that falling in the coastal mountains. Very little rain falls in May and October, usually near half an inch, and almost none from June through September. A majority of the rainfall comes in December, January and February, about 3.5 inches per month in normal rainfall years. The annual average rainfall in the South Bay is in the 13 - 15 inch range.

B. Wind Charactistics in the South Bay

Wind in the South Bay is predominantly from the northwest, approximately 30% of the time during the winter, and over 50% during the summer months, as shown in the summary of wind data for downtown San Jose presented in Exhibit 1. The northwest winds are a result of ocean-driven flow coming through the Golden Gate and toward the south bay. During mid-winter months southeasterly winds are present nearly 40% of the time due to freqent low-pressure storm fronts, and their characteristic counter-clockwise flow. Calm conditions occur nearly 13% of the time during the winter, but only 5% during the summer.

EXHIBIT 1 - San Jose Wind Setting

Direction	% of Time	Mean Speed (mph)
<u>Annual Distribution</u>		
NE	3.1	1.5
E	0.5	1.4
SE	16.9	2.7
S	19.2	4.2
SW	6.8	2.2
W	1.1	2.5
NW	40.7	4.3
N	2.9	2.4
Calm	8.9	---
	100	3.3
<u>Winter Distribution</u>		
NE	2.9	1.5
E	0.5	1.4
SE	20.8	2.6
S	23.5	4.4
SW	7.9	1.9
W	1.5	2.4
NW	28.1	3.9
N	2.1	2.6
Calm	12.7	---
	100	3.0
<u>Summer Distribution</u>		
NE	3.0	1.5
E	0.4	1.5
SE	11.4	3.0
S	17.4	4.3
SW	5.4	2.6
W	0.6	2.9
NW	52.8	4.6
N	3.9	2.4
Calm	5.1	---
	100	3.8

Average wind speeds in the downtown San Jose project area are less than 5 mph on an annual average basis. The highest wind speeds occur during late afternoon on-shore cooling in the summer, and during winter storms. During storm periods winds frequently gust at 20 to 30 mph.

C. Ambient Air Quality

Air quality near the project area in downton San Jose is subject to the problems experienced by most of the Bay Area, and particularly the south portion. Emissions from millions of vehicle-miles of travel each day often are not mixed and diluted, but are trapped near ground level by a temperature inversion. Prevailing air currents generally sweep from the mouth of the Bay toward the south, picking up and concentrating pollutants in the basin around San Jose and the Almaden Valley. A combination of emissions in the South Bay, the transport of pollutants from other areas, and the natural mountain barriers (the Diablo Range to the east and the Santa Cruz Range to the southwest) produce high concentrations, which sometimes exceed ambient air quality limits established by the Bay Area Air Quality Management District (BAAQMD). The most recent air quality data from the nearest BAAQMD monitoring station on 4th Street in San Jose, and the ambient standards presently in effect, are tabulated in Exhibit 2.

Ozone, the primary oxidant "smog" component, is produced by complex reactions of hydrocarbons and NO_x in the atmosphere. Daily ozone concentrations are heavily dependent upon the weather, and thus vary substantially from year to year. Since the adverse atmospheric conditions in 1978, when 12 exceedances were recorded in San Jose, high oxidant days had been significantly lower. However, 1983 and 1984 were unusually warm and stratified ozone seasons, with 9 and 7 exceedances, respectively. The 1985 and 1986 summer weather was cooler and had a more normal ventilation pattern, bringing ozone exceedances back down. The 3-year Expected Annual Exceedance value (average of last three years) is now 3.3.

EXHIBIT 1

AMBIENT AIR QUALITY

Downtown San Jose

POLLUTANT	1984	1985	1986	Std	Meas. Units
OZONE					
Maximum	16	14	14	12 (1)	pphm, 1-hr ave
Exceedances	7	2	1	1	days per year
3-year average	5.3	6.0	3.3	1	Expected Annual Exceedances
CARBON MONOXIDE					
Maximum 8-hour	20	21	11	9 (2)	ppm, 8-hr ave
8-hour exceedances	5	17	4	1	days per year
NITROGEN DIOXIDE					
Maximum	18	19	16	25 (3)	pphm 1-hr ave
Exceedances	0	0	0	1	days per year
TOTAL SUSPENDED PARTICULATES (6)					
Annual mean	46	53	50	60 (4)	annual geometric mean
Daily exceedances	0	1	0	1 (5)	% of days above 150 ug/m^3

NOTES:

(1) Federal standard; State standard is 10 pphm.
(2) Federal and State ambient standard; State standard is also 20 pphm for 1 hour.
(3) State standard; Federal standard is 5 pphm annual average.
(4) State standard; Federal standard is 75 ug/m^3.
(5) Federal standard; State standard is 100 ug/m^3, measured as thoracic particles (small diameter).
(6) Measurements from Moorpark Ave station, San Jose.

Source: BAAQMD monitoring data -- 4th Street station, S.J.

Another problem pollutant in the South Bay, carbon monoxide, like oxidant, is also heavily dependent upon both vehicle emissions and weather. High CO concentrations in the South Bay occur mostly during winter evenings with little wind. Exceedances of the 9 ppm 8-hour ambient standard increased to 17 during 1985 in San Jose, the highest number of exceedances since 1979, but dropped again in 1986, to 4 incidents. Both CO and oxidant have been reduced significantly by improved emission controls on new automobiles in the past decade.

Total suspended particulates, produced by vehicles, heavy industry, and soil-moving activities, dropped impressively in 1983, but heavy construction in downtown San Jose have produced high concentrations since 1984. The ambient standard of 100 ug/m^3 for 24-hour sampling has been exceeded a significant number of the days tested in downtown San Jose for the past three years. The Moorpark station readings for TSP are considered more representative of the general San Jose exposure, and they are presented in Exhibit 2.

Sulfur dioxide is primarily associated with chemical and refining industries, and has never approached the ambient standard in the San Jose area, nor have SO_2 standards been exceeded anywhere in the District since 1976, and are not reported now in the South Bay.

Nitrogen oxides are produced heavily by vehicles and high-temperature industrial operations, but as yet have not posed serious problems in the region. The South Bay often has the highest NO_x concentrations in the District, however.

Because there are exceedances of some ambient standards in the Bay Area, the District has been designated a Non-Attainment Area by the Environmental Protection Agency for CO, ozone, and TSP. All significant sources in the District must share responsibility for basin exceedances, including those sources in locations where air quality is good.

II. POTENTIAL AIR QUALITY IMPACTS OF PROJECT

The scope of the San Jose Sports Arena project is the siting and construction of a new City Sports Arena in one of three locations in the San Jose metropolitan area. This study evaluates potential air quality impacts associated with the "Site C" alternative at Route 237 and Zanker Road. The project includes surface lot parking on the site for 5300 vehicles.

Vehicle trips carrying patrons to and from events at the Sports Arena are the primary sources of emissions associated with the implementation of the project. The trip profile associated with the Sports Arena is an incoming group of vehicles (approximately one vehicle per 3 patrons) in the 90 minutes or so prior to event starting time, and the reverse trip pattern in the 60 minutes following the event. This profile is essentially superimposed upon the existing commute-based traffic pattern. The peak arrival traffic for a normal weekday evening event is expected to follow the afternoon peak commute period closely, but not coincide with it.

Other types of air quality impacts associated with this project, such as stationary sources of pollutants and heating system emissions, represent minimal contributions. Potential dust and particulates generated during site preparation and grading may be controlled by routine application of water and/or road oil.

Particulates generated by roadway resuspension are relatively small amounts very near the roadway. Although it is possible to estimate a range of values for these contributions, the estimates would have little validity except under specific and controlled conditions not found in actual practice.

A. Sensitive Receptor Locations

Sensitive receptors for potential air quality impacts of the San Jose Sports Arena project at Site C are primarily (1) the Agnews State Hospital complex about a half mile south, and (2) a mobile home park across Zanker Road from the site, which have been selected as representative receptor locations for evaluation (refer to the Project Map, Appendix Page A-3). The extent to

which these locations would be affected by the proposed project is evaluated in the following sections. Other receptor locations in the project area would experience similar or lesser impacts.

B. Data and Methodology

Vehicles are responsible for emission of a number of pollutants -- carbon monoxide (CO), hydrocarbons, particulates, NOx, and others. The most widely-used method of evaluating the potential impact of project vehicular emissions is modeling the concentration of CO at nearby sensitive receptor locations.

Vehicular carbon monoxide emissions are directly related to the number of vehicle trips, and to the average vehicle emission rate. Newer vehicles have lower emission rates than older vehicles because of better emission controls. In addition, average emissions per mile decrease as average speed increases. But after the pollutants are emitted, atmospheric conditions control pollutant mixing, dispersion, and the ultimate concentrations achieved. These interrelated factors are considered in a simplified way by roadside CO dispersion modeling.

The CALINE 3 multiple line-source model used for this study was developed by the California Department of Transportation (Ref. 5), based upon standard Gaussian diffusion relationships developed by Turner (Ref. 6) and others. In basic terms, CALINE takes emissions from major arterials in the area, under stagnated atmospheric conditions and low wind speed, and sums the contributions of major roadways at selected receptors for various wind directions.

To evaluate the potential air quality impacts, four traffic conditions are evaluated and compared, based upon the traffic study for the project by Barton-Aschman Associates, Inc, San Jose (July 1987):

1. Existing 1987 traffic

2. Base case 1991 traffic

3. Year 1991 traffic, 20,000-patron event

4. Year 2000 traffic, 20,000-patron event

A list of specific streets included in the analysis is given in Exhibit 3.

CALINE modeling parameters, and input geometric and traffic parameters used are described on Appendix Page A-4. Sample modeling summary sheets for three traffic conditions are on the following pages in the Appendix, which give parameter values as well as the resulting CO concentrations in parts per million (ppm) for each receptor. Composite vehicle emission factors are taken from the California Air Resources Board EMFAC 6 program (Ref. 7).

Exhibit 3
Streets Modeled with CALINE

State Route 237
Interstate I-880
Zanker Road
North First Street
Montague Expressway

Note: Streets are modeled in 2 or 3 segments

C. Impact Analyses

Carbon monoxide concentrations at the two receptors have been modeled during peak hour for each traffic condition and for eight wind conditions. Emissions are accumulated by CALINE from each of 13 street segments ("links") in the project area defined by the streets listed in Exhibit 3. CO concentrations for the wind directions giving the highest values are tabulated in Exhibit 4 below for the six cases.

Exhibit 4

PEAK HOUR CARBON MONOXIDE MODELING (ppm)

CASE	RECEPTOR 1	RECEPTOR 2
1. Existing - 1987	0.2	0.4
2. Base case - 1991	0.5	0.8
3. Year 1991 - 20,000	0.5	0.8
4. Year 2000 - 20,000	0.4	0.7

Local Background Concentration : 7 ppm
Ambient Standard : 20 ppm

Exhibit 4 shows that traffic associated with the Sports Arena at Site C will not increase air quality concentrations at residential receptors in the vicinity in any significant way. This is because project traffic volumes will be distributed on a number of access streets in the area, while average emissions per vehicle continue to be reduced, as newer vehicles with superior emission controls replace older vehicles.

Background concentrations are the combined result of vehicular emissions from all streets in an area; the values listed are taken from Pages V-10 and V-11 of the BAAQMD Assessment Guidelines (Ref. 8). The total CO concentrations under stagnated atmospheric conditions are the sum of local background plus the modeled concentrations, which would not appear to cause the State ambient standards to be exceeded, with or without the project.

However, some simplifications are made by the modeling procedure, one of which is to assume a constant lower-speed traffic flow during peak hour conditions, rather than stop-and-go cycles. At some congested intersections, emissions could be higher than modeled. In addition, under severe atmospheric stagnation which occurs a few times each year (near-zero wind speeds and a very low atmospheric inversion, which cannot be modeled in a straightforward fashion), ambient standards could be exceeded. To the extent that Sports Arena events coincide with these stagnation periods, the project would contribute to increased local CO concentrations at a time when ambient standards are exceeded throughout the south bay region.

D. Total Project Emissions

Another way of assessing potential air quality impacts is to estimate the total daily project-related vehicular emissions. The Sports Arena will not have a consistant "daily" contribution, but an event could occur a few times per week. Total emissions are computed by considering the emissions associated with the 6,500 project trips with an average trip length of 20 miles (per Ref. 8, Table VI-B-1). Exhibit 5 is a comparison of total emissions for the four pollutants of concern.

Exhibit 5

Emissions Comparisons (1995 - Tons per day)

	CO	NMHC	NOx	PART
Project	0.18	.015	.019	.004
BAAQM District				
Vehicle	1430	142	183	351
Total	2160	532	486	708
Santa Clara County				
Vehicle	24%	12%	14%	12%
Total	26%	24%	18%	23%

Emissions are converted to tons per day to relate them to the estimated total District vehicular emissions in the year 1995. Santa Clara County emissions, as a percent of District emissions, also are tabulated for comparison. All non-project emission estimates are from Reference 9.

E. Relationship Of Project To District Air Quality Plan (AQP)

The 1982 Bay Area Air Quality Plan (Ref. 9) presents the policies and methods adopted for meeting the mandated National Ambient Air Quality Standards in the Bay Area. The recommended policies in the AQP which would be most relevent to reviewing agencies and individual projects are designated "Transportation Control Measures (TCMs)," acknowledging the primary role vehicles play in air quality control problems and their solution.

F. Parking-Lot Air Quality Impacts

In addition to the emissions generated by the Sports Arena patrons driving to and from the site, short-term emission incidents would be produced while the vehicles are entering and leaving the parking lot, particularly while leaving. After an event patrons leave essentially at the same time, with many vehicles idling while in queue to exit the parking lots. This section discusses concentrations adjacent to the Sports Arena parking lots.

<u>Parking Lot Idling Emissions</u>

The receptor CO concentrations downwind from an area source such as a parking lot are given in the following relationship from Reference 10:

$$C = \frac{0.8\, Q\, (x2^{(1-b)} - x1^{(1-b)})}{A\, U\, a\, (1-b)\, R}$$

where

x1 = the distance to the near boundary of lot (meters)
x2 = the distance to the far boundary of lot (meters)
A = area of parking lot ($meters^2$)
U = wind speed (meters/sec)
a,b = atmospheric dispersion parameters
Q = emission rate of lot (mg/sec)
R = conversion factor from mg/m^3 to ppm
C = concentration of CO (ppm)

Using this model to estimate concentrations at the mobil home park receptor across Zanker Road (95 meters) from the primary parking lots (4840-vehicles) , assuming poor atmospheric conditions, 1 meter per second wind speed, a full lot of vehicles idling at once, the receptor concentration of CO would be 11 ppm.

III. AIR QUALITY MITIGATION MEASURES

Mitigation thresholds for potential air quality impacts are described and classified by type of project in the BAAQMD Assessment Guidelines (Ref 8). From Table IX-B-3, the San Jose Arena project is below the Category C mitigation threshold for planning actions affecting any facility generating more than 5,000 vehicles.

Measures relevant to the Sports Arena, taken from the full range of potential air quality mitigation measures described in detail in Section IX of the new BAAQMD Guidelines, are summarized in the following paragraphs. The recommended mitigations should be given serious consideration for implementation by the City of San Jose planning and development review agencies. The recommended transportation-related mitigations should be considered by both City and Santa Clara County transportation planning agencies.

A. PHYSICAL FACILITIES to support improvements in transit and flow of traffic.

1. Bicycle and Pedestrian Facility Improvements. Includes pedestrian pathways, safe bicycle routes and secure bicycle storage facilities.

2. Transit Improvements and Amenities. Additional transit stops, bus turnouts and shelters, passenger amenities, and special bus and carpool lanes.

3. Street And Traffic Flow Improvements. Traffic engineering changes which improve traffic flow, such as more lanes, turning lanes, and demand signalization of intersections, can make significant improvements; an average vehicle speed increase of 5 mph can achieve a 20% reduction in CO and hydrocarbon emissions.

4. Site Plan Changes for better traffic flow.

B. TRANSPORTATION-RELATED MANAGEMENT ACTIONS to encourage single-occupant patrons to switch to either public transit or multiple- passenger vehicles.

1. Transit Incentives and Agreements to improve project/transit interactions, such as improved routes and schedules to serve the project.

In practice, the effectiveness of any mitigation measure is directly proportional to reductions in traffic flow congestion and to the number of drivers that are willing to give up single-occupant travel. Actual reductions in emissions vary between 1 to 15% depending upon the measure. Clearly, the effectiveness of transportation alternatives is improved as the alternatives are made more attractive to drivers relative to travel in single-occupant vehicles. More detailed coverage of vehicular emission mitigation measures and associated benefits are presented in Section IX of Reference 10.

IV. UNAVOIDABLE AIR QUALITY IMPACTS WHICH CANNOT BE FULLY MITIGATED

1. Significant increases in CO concentrations near congested intersections and parking lots during arrival and departure of Sports Arena patrons under poor atmospheric conditions.

AIR QUALITY REFERENCES

BAY AREA CLIMATOLOGY

1. Felton, E.L., California's Many Climates, Pacific Books, Palo Alto, 1965.

2. Gilliam, H., Weather of the San Francisco Bay Region, University of California Press, Berkeley, 1962.

AIR QUALITY

3. "Contaminant and Weather Summary", monthly station monitoring data, Bay Area Air Quality Management District, San Francisco.

4. Annual summaries of station air quality data, BAAQMD, San Francisco.

MODELING

5. Benson, Paul, CALINE 3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, Report No. FHWA/CA/TL - 79/23, California Dept. of Transportation, Sacramento, Nov 1979. IBM-based computer program by California Air Resources Board.

6. Turner, D. Bruce, Workbook of Atmospheric Dispersion Estimates, AP-26, U.S. Environmental Protection Agency, 1970.

7. "ENV028" computer program to determine annual composite vehicle emission rates, based upon "EMFAC 6D" vehicle-specific emission rate program, California Air Resources Board, Sacramento.

8. Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans, Planning Division, Bay Area Air Quality Management District, San Francisco, November 1985.

9. 1982 Bay Area Air Quality Plan, Association of Bay Area Governments (with Metropolitan Transportation Commission and BAAQMD), Berkeley, Dec 1982.

10. Guidelines for AQ Maintenance Planning and Analysis, Volume 9 (Revised): Evaluating Indirect Sources, Report EPA-450/4-78-001, U.S. Environmental Protection Agency, Research Triangle Park, NC, Sept 1978.

APPENDIX

COMMON AIR QUALITY TERMS AND DEFINITIONS

Air basin or airshed - a region which, due to its geography and topography, tends to contain air pollutants emitted within it.

Air pollutant - a substance in the atmosphere which is harmful or undesirable.

Air quality - the amount of pollutants in the air relative to existing ambient air quality standards*.

Air Resources Board (ARB) - California agency responsible for state air quality planning and control program.

Ambient Air Quality Standards - exposure limits established for various air pollutants by state and federal agencies.

Bay Area Air Quality Management District (BAAQMD) - nine-county agency responsible for air quality planning and control in the San Francisco Bay area.

Carbon monoxide (CO) - an odorless and invisible gas pollutant produced primarily by vehicle operation. Reduces oxygen-carrying capacity of the blood, causing headache, fatigue, coordination disfunction, and cardio-respiratory stress.

Concentration - the amount of a pollutant in a given volume or sample of air.

Department of Environmental Protection (NDEP) - Nevada agency responsible for state air quality planning and control programs.

Dispersion - the process of mixing, dilution, and transport of air pollutants.

Emission - discharge of a substance into the air.

Environmental Protection Agency (EPA) - federal agency with overall responsibility for national and state air quality planning and control programs.

Hydrocarbons (HC) - a large group of compounds containing hydrogen, carbon and various other elements, and found in fossil fuels, paints and solvents. They cause plant damage, odor, and contribute to smog* formation.

Inversion - a reversal of the normal temperature lapse rate* in the atmosphere, producing a stable high-temperature layer above a lower-temperature layer.

Line source - a linear group of pollutant emitters, such as vehicles on a roadway.

Micrograms per cubic meter ($\mu g/m^3$) - a common unit of measurement of particulate concentration* in weight per unit volume.

Mixing layer - when an atmospheric temperature inversion* exists, the layer of air below the inversion altitude in which air pollutants are confined.

Modeling - a technique of using estimated source emissions and meteorological information to compute expected air pollutant concentrations.

Monitoring - regular measurement of air pollutant concentrations.

Nitrogen oxides (NO_x)- formed during high-temperature combustion processes, several gaseous pollutants cause plant damage, eye and lung irritation, and discoloration of materials. Nitrogen dioxide causes the typical brown color of smog.*

Odor - can be aesthetically unpleasant, and cause illness in some cases. Common problem gases include hydrogen sulfide, ammonia, and some organic vapors.

*defined elsewhere

Organic compounds - a very large group of substances containing carbon, found in all living matter, and also fossil material such as coal and petroleum. They are often released when extracted, processed, and/or burned.

Oxidants - a highly-active group of chemicals (mostly ozone in air) formed in the atmosphere by the photochemical reaction* of hydrocarbons*, nitrogen oxides*, and sunlight. Causes extensive vegetation damage, eye irritation, headache, and impaired breathing.

Ozone (O_3) - see Oxidants above.

Particulates, total suspended (TSP) - include solid particles, dust, and smoke, and are produced by industrial processes, combustion, and vehicles. They damage plants and materials, reduce sunlight and visibility, and carry irritating chemicals into the respiratory system.

Parts per million (ppm) - a common unit of measurement of gaseous pollutant concentration in relative volume of pollutant per million volumes of air.

Photochemical reaction - the atmospheric combination of hydrocarbons* and oxides of nitrogen to form oxidants* and smog*, driven by the energy from intense sunlight.

Point source - a single stationary souce of air pollution.

Primary air quality standards - recommended limits to air pollutant concentrations based upon criteria for protection of human health.

Secondary air quality standards - recommended limits to air pollutant concentrations based upon criteria for protection of property and aesthetics.

Smog - the combination of air pollutants found during intense photochemical reaction.*

Source - a process, activity, or machine which emits air pollution.

Stagnation - an extremely stable atmospheric condition in which little vertical or horizontal dispersion* of emitted pollutants occurs.

Sulfur oxides - are produced by processing and combustion of fossil fuels which have sulfur content. These gaseous pollutants are toxic to plants, deteriorate materials, and in combination with particulates, contribute to serious respiratory illness.

Temperature lapse rate - the normal atmospheric temperature profile which decreases as altitude increases. See Inversion*.

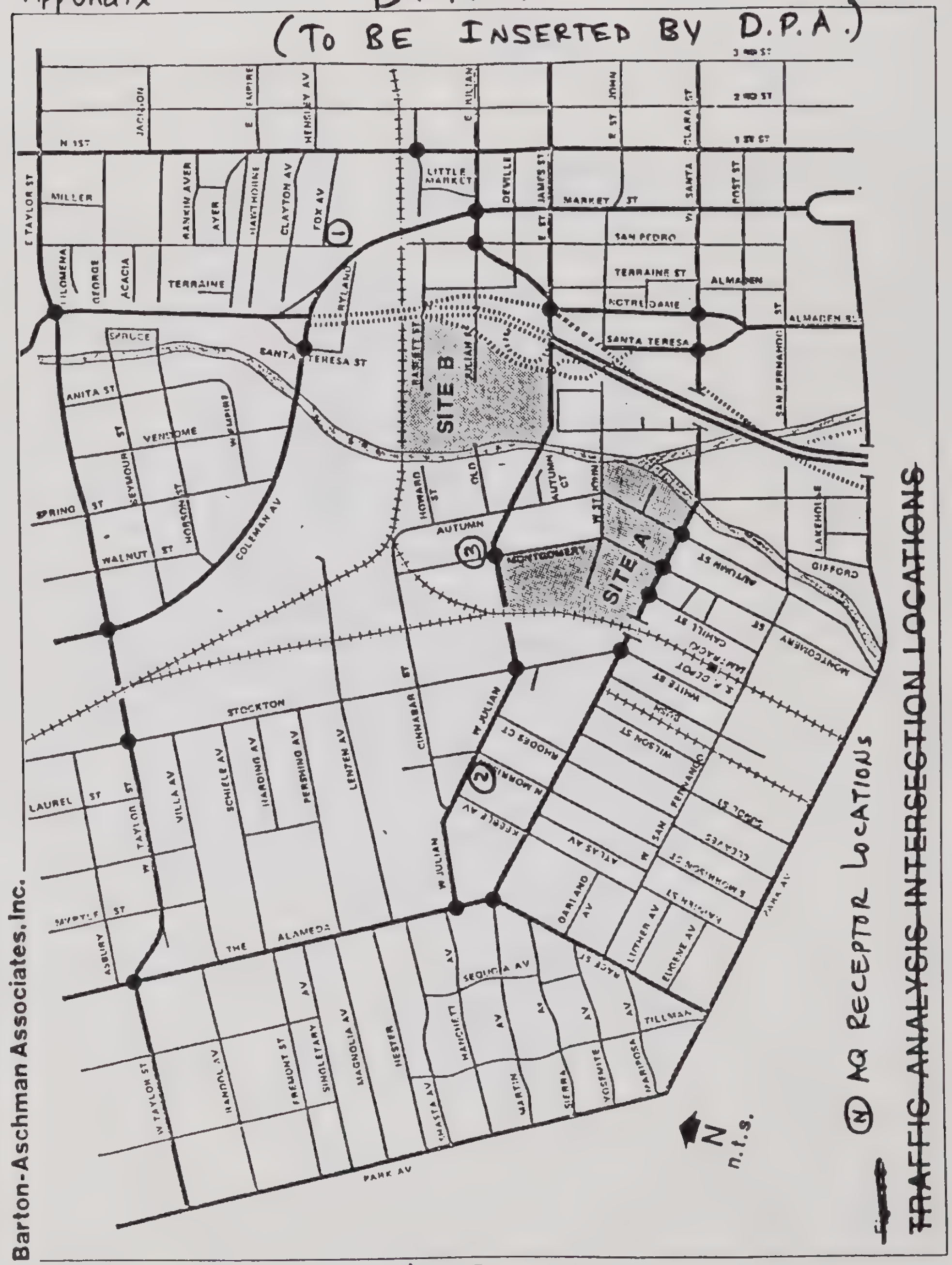
Transport - the movement of emitted pollutants by wind or thermal action.

Visibility reduction - is caused by suspended very small particles, water vapor, smoke, and gases with color.

*defined elsewhere

Appendix DRAFT

(To BE INSERTED BY D.P.A.)



APPENDIX

CALINE 3 VARIABLE DESCRIPTIONS

SITE VARIABLES

Run	title of modeling run
U	wind speed (m/sec)
MIXH	atmospheric mixing height (m)
ZO	measure of roughness of surface topography (cm)
BRG	wind direction (degrees)
ATIM	averaging time (min)
VS	settling velocity (cm/sec)
CLASS	atmospheric stability class 1 = least stable, 6 = most stable
AMB	ambient concentration (set to zero to highlight project contributions)
VD	deposition velocity (cm/sec)

LINK VARIABLES

1,2,...	link (street segment) number
X,Y	link end coordinates
TYPE	link type: AG= at grade, FL= fill, BR= bridge, DP= depressed
VPH	traffic volume (vehicles/hour)
EF	composite emission factor (gms/mi)
H	link height (m)
W	street width (m)

RECEPTOR COORDINATES

1,2,3...	receptor number
X,Y,Z	receptor coordinates, elevation

MODEL RESULTS

CO/LINK	CO contributions by link
TOTAL	total concentration at receptor

CALINE3

RUN :(2) SAN JOSE ARENA SITE C

1.0 SITE VARIABLES

```
   U=  2  M/S    BRG=  45  DEGREES  CLASS=  6
MIXH= 1000  M  ATIM=  60  MINUTES    AMB=  0  PPM
  Z0=  100  CM    VS=  0  CM/S          VD=  0  CM/S
```

2.0 LINK VARIABLES

LINK	LINK COORDINATES (M) X1	Y1	X2	Y2
1	-875	2366	1827	2462
2	1827	2462	4313	3085
3	5511	-1450	5002	479
4	5002	479	4313	3085
5	4313	3085	4103	3983
6	1977	4163	2246	2564
7	2246	2564	2845	150
8	2845	150	4475	-2276
9	-3205	-1288	1707	1402
10	1707	1402	-1198	3564
11	803	-899	3265	234
12	3265	234	3935	-473
13	3935	-473	5002	479

CALINE3
RUN #(2) SAN JOSE ARENA SITE C

LINK	*	TYPE	VPH	EF	H	W
1	*	AG	8060	14.4	0	27.6
2	*	AG	8780	14.4	0	27.6
3	*	AG	10000	12.3	0	31.3
4	*	AG	10000	12.3	0	31.3
5	*	AG	10000	12.3	0	31.3
6	*	AG	680	14.4	0	20.7
7	*	AG	2240	14.4	0	20.7
8	*	AG	1000	14.4	0	20.7
9	*	AG	3500	14.4	0	28
10	*	AG	3170	14.4	0	28
11	*	AG	7900	14.4	0	31.3
12	*	AG	4900	14.4	0	31.3
13	*	AG	4800	14.4	0	31.3

LINK DESCRIPTORS

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	*	X	Y	Z
1	*	2678	1258	1.8
2	*	2246	2264	1.8

4.0 MODEL RESULTS

RECEPTOR	* CO/LINK 1	2	3	4	5	6	7	8	9	10	11	12	13	* TOTAL PPM
1	0	0	0	.1	0	0	0	0	0	0	0	0		.1
2	0	.6	0	0	0	0	.2	0	0	0	0	0		.8

CALINE3
RUN #(3) SAN JOSE ARENA SITE C

1.0 SITE VARIABLES

U= 2 M/S BRG= 0 DEGREES CLASS= 6
MIXH= 1000 M ATIM= 60 MINUTES AMB= 0 PPM
Z0= 100 CM VS= 0 CM/S VD= 0 CM/S

2.0 LINK VARIABLES

LINK COORDINATES (M)

LINK	*	X1	Y1	X2	Y2
1	*	-875	2366	1827	2462
2	*	1827	2462	4313	3085
3	*	5511	-1450	5002	479
4	*	5002	479	4313	3085
5	*	4313	3085	4103	3983
6	*	1977	4163	2246	2564
7	*	2246	2564	2845	150
8	*	2845	150	4475	-2276
9	*	3205	-1288	1707	1402
10	*	1707	1402	-1198	3564
11	*	803	-899	3265	234
12	*	3265	234	3935	-473
13	*	3935	-473	5002	479

CALINE3

RUN : (3) SAN JOSE ARENA SITE C

LINK *	LINK DESCRIPTORS TYPE	VPH	EF	H	W *
1 *	AG	8130	14.4	0	27.6
2 *	AG	8820	14.4	0	27.6
3 *	AG	12600	12.3	0	31.3
4 *	AG	12000	12.3	0	31.3
5 *	AG	10650	12.3	0	31.3
6 *	AG	680	14.4	0	20.7
7 *	AG	2350	14.4	0	20.7
8 *	AG	1000	14.4	0	20.7
9 *	AG	3490	14.4	0	28
10 *	AG	3170	14.4	0	28
11 *	AG	8050	14.4	0	31.3
12 *	AG	4990	14.4	0	31.3
13 *	AG	4500	14.4	0	31.3

3.0 RECEPTOR COORDINATES (M)

RECEPTOR *	X	Y	Z *
1 *	2678	1248	1.[illegible]
2 *	2246	2264	1.[illegible]

4.0 MODEL RESULTS

RECEPTOR *	CO/LINK 1	2	3	4	5	6	7	8	9	10	11	12	13	*TOTAL PPM
1 *	0	.1	0	0	0	0	0	0	0	0	0	0		.1
2 *	0	.4	0	0	0	.1	.2	0	0	0	0	0		.7

CALINE3

RUN : (4) SAN JOSE ARENA SITE C

1.0 SITE VARIABLES

U= 2 M/S BRG= 180 DEGREES CLASS= 6
MIXH= 1000 M ATIM= 60 MINUTES AMB= 0 PPM
Z0= 200 CM VS= 0 CM/S VD= 0 CM/S

2.0 LINK VARIABLES

LINK *	LINK COORDINATES (M) X1	Y1	X2	Y2 *
1 *	-875	2366	1827	2462
2 *	1827	2462	4313	3085
3 *	5511	-1450	5002	479
4 *	5002	479	4313	3085
5 *	4313	3085	4103	3983
6 *	1977	4163	2246	2564
7 *	2246	2564	2845	150
8 *	2845	150	4475	-2276
9 *	3205	-1288	1707	1402
10 *	1707	1402	-1198	3564
11 *	803	-899	3265	234
12 *	3265	234	3935	-473
13 *	3935	-473	5002	479

CALINE3

RUN #(4) SAN JOSE ARENA SITE C

LINK DESCRIPTORS

LINK	TYPE	VPH	EF	H	W
1	AG	8100	12.1	0	27.6
2	AG	8900	12.1	0	27.6
3	AG	14600	10.3	0	31.3
4	AG	14000	10.3	0	31.3
5	AG	12650	10.3	0	31.3
6	AG	730	12.1	0	20.7
7	AG	2900	12.1	0	20.7
8	AG	1650	12.1	0	20.7
9	AG	3430	12.1	0	28
10	AG	3200	12.1	0	28
11	AG	4250	12.1	0	31.3
12	AG	3400	12.1	0	31.3
13	AG	3200	12.1	0	31.3

3.0 RECEPTOR COORDINATES (M)

RECEPTOR	X	Y	Z
1	2678	1258	1.3
2	2246	2264	1.3

4.0 MODEL RESULTS

RECEPTOR	CO/LINK 1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL PPM
1	0	0	0	0	0	0	.3	0	.1	0	0	0		.4
2	0	0	0	0	0	0	0	0	.1	0	0	0		.1

APPENDIX C-3

ACOUSTICAL ANALYSIS

EDWARD L. PACK ASSOCIAITES, INCORPORATED

SANTA CLARA, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

EDWARD L. PACK ASSOCIATES, INC.
Consulting Engineers
TELEPHONE (408) 727-6840
2940 SCOTT BOULEVARD
SANTA CLARA, CALIF 95054

July 29, 1987
Project No. 19-047

Mr. David Powers
David J. Powers Associates
1885 The Alameda, Suite 210
San Jose, CA 95126

Subject: Traffic Noise Impact Assessment for a Proposed Arena, Site "C", Highway 237 and Zanker Road, San Jose

Dear Mr. Powers:

This report presents the results of a noise assessment study for the proposed arena, Site "C", at Zanker Road and State Route (SR) 237, as shown on the Site Plan, Ref. (a), and Figure 1, herein. This assessment includes a description of the existing acoustical environment, results of the noise measurements, noise impacts that would result from the project, a discussion of the applicable standards, and mitigation measures required to achieve compliance with the standards. Appendices A and B, attached, include the list of references, description of the applicable standards, terminology and a description of the instrumentation used for the field survey.

Figure 1. Site Plan Showing Location of Arena, Site "C".

I. Acoustical Setting

A. Site Description

Site "C" is a site being considered for a proposed arena in San Jose. This site is located on the southeast corner of the intersection of Zanker Road and SR 237, and is currently occupied by a Santa Clara County Transit District maintenance facility. The site is surrounded by agricultural land, except for a mobile home park located across Zanker Road to the southwest. As reported by the traffic consultant for the project, Ref. (b), Zanker Road carries an Average Daily Traffic (ADT) of 8235 south of its intersection with SR 237, and SR 237 carries an ADT of 51,990 west of its intersection with Zanker Road.

B. Existing Noise Levels

The existing noise environment at the site is created primarily by traffic noise from Zanker Road and SR 237. To determine the existing noise levels, continuous recordings of the sound levels were taken at two locations, corresponding to the north and west setbacks of the proposed arena. The noise level measurements were made on April 28 and May 26, 1987 for a total period of 15 hours, with representative hours during the daytime and nighttime periods. The primary instrument used for the recordings was a Gen Rad Company Community Noise Analyzer, which computes and yields by direct readout a series of descriptors of the sound levels versus time. The results of the recordings for the measurement locations are presented in Table I, below. The descriptors shown in the table

are the L_{10}, L_{50} and L_{90}, i.e., those levels that are exceeded 10%, 50% and 90% of the time. Also shown are the maximum and minimum levels, and the continuous equivalent level (L_{eq}), which is used to calculate the day-night level (L_{dn}). The day-night level is a 24-hour noise descriptor used by the City of San Jose noise standards to define acceptable noise environments. The L_{dn} is calculated as a decibel average of the measured L_{eq} values, with adjustments applied to represent average traffic conditions, utilizing procedures developed by the Highway Research Board, Ref. (c). The L_{dn} has a daytime period (7:00 a.m. to 10:00 p.m.), and a nighttime period (10:00 p.m. to 7:00 a.m.), with a weighting factor applied to the nighttime period to account for the increased sensitivity to noise during the nighttime hours. The mathematical formula used to calculate the L_{dn} is shown in Appendix B.

As shown in Table I, the L_{eq} values ranged from 50 to 61 dBA at the Zanker Road measurement location, and from 54 to 63 dBA at the SR 237 location. Calculation of the L_{dn} values revealed existing levels of 59 dB L_{dn} at the setback location along Zanker Road, and 63 dB L_{dn} at the setback location along SR 237.

TABLE I

Measured Noise Levels at Two Locations
for Arena Site "C",
April 28 and May 26, 1987

Location and Time Period	Noise Levels, dBA					
Loc.1: 200 Ft. from Edge-of-Pavement of Zanker Road	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}	L_{eq}
2:15 - 3:15 pm	79	62	57	53	48	61
3:15 - 4:15 pm	80	59	57	54	50	58
4:20 - 5:20 pm	78	59	55	52	48	58
8:30 - 9:30 pm	76	54	49	46	41	54
9:30 - 10:30 pm	73	54	48	47	41	52
10:30 - 11:30 pm	66	53	50	46	41	51
11:30 pm - 12:30 am	62	52	49	45	40	50
Loc. 2: 400 Ft. from the Edge-of-Pavement of SR 237						
2:20 - 3:20 pm	85	65	58	53	49	63
3:20 - 4:20 pm	79	63	60	57	51	61
4:25 - 5:25 pm	80	64	61	58	54	63
5:30 - 6:30 pm	85	65	58	54	50	63
8:30 - 9:30 pm	72	57	53	49	45	55
9:30 - 10:30 pm	75	58	54	51	45	56
10:30 - 11:30 pm	69	57	53	50	44	54
11:30 pm - 12:30 am	65	57	53	50	44	54

As reported by the San Jose Planning Department, Ref. (d), the General Plan designation for the site, as well as the surrounding area east of Zanker Road and south of SR 237, is for public and quasi-public buildings, including arenas. Other areas surrounding the site are designated for industrial uses, with the exception of the mobile home park. Noise standards contained in the Noise Element of the San Jose General Plan, Ref. (e), apply to all new development within the City of San Jose. The standards specify an exterior noise limit of 60 dB L_{dn} for public, quasi-public and residential uses, and 70 dB L_{dn} for industrial uses. When levels are over these limits, the project would be considered incompatible unless adequate acoustical mitigation can be provided.

II. Impacts

Noise level impacts associated with the proposed project involve both project-generated impacts and noise impacting the project. Project-generated impacts include increased noise levels from project-generated traffic on Zanker Road and SR 237; noise impacts generated by the arena from crowds, loudspeaker systems, and other sources while the arena is in use; and construction noise impacts. Noise impacting the project would be generated by traffic sources on Zanker Road and SR 237. These impacts are discussed below.

A. Project-Generated Impacts

1. Traffic Noise

The project would generate increased traffic volumes on Zanker Road and SR 237 in the site vicinity. During weekdays, these increases would occur during the hours of 4-8 p.m. and 10 p.m. to 12 midnight. Arena traffic would also be generated on weekends, however, weekend traffic data were not available at the time of this study. Table II, below, shows the increases in the L_{dn} (24-hour average) that would occur under future traffic conditions, both with and without arena traffic. Table III shows the increase in the L_{eq} levels during the three peak arena usage periods when arena traffic will be heaviest. These increases in the L_{eq} are based on the ambient traffic noise levels for Year 1991 without the arena.

The L_{dn} values given in Table II are shown so that increases in the 24-hour average levels can be evaluated against the City of San Jose standards. The noise level increases given in Table III are in terms of the L_{eq}, and indicate the peak hour noise level increases that would be experienced along the surrounding roadways. The impacts associated with these noise level increases, as determined by the U.S. Environmental Protection Agency, are given in the impact listing which follows Tables II and III.

TABLE II

Predicted Future Noise Level Increases Over Existing Levels, in dB L_{dn}

	Noise Levels, dB L_{dn}				
		Year 1991		Year 2000	
Location	Existing	w/o Arena	w/Arena	w/o Arena	w/Arena
Zanker Rd., So. of SR 237	59	61	63	64	65
Zanker Rd., No. of Montague Expwy.	60	65	66	66	67
SR 237, near Zanker Rd.	63	65	65	65	65

TABLE III

Project-Generated Traffic and Noise Level Increases Over Year 1991 Values W/O Project For Three Peak Hour Periods

Location	Time Period	Increase in Traffic Over Non-Arena Vol. %	Increase in Noise Levels Over Non-Arena Levels dBA, L_{eq}
Zanker Rd.	4-6 pm	15	+1
	6-8 pm	498	+8
	10 pm-12 M	1284	+11
SR 237	4-6 pm	1	0
	6-8 pm	27	+1
	10 pm-12 M	67	+2

Note: Year 2000 traffic projections not available

The following is a listing of predicted impacts from an increase in the noise levels, as developed by the Environmental Protection Agency (EPA), and used to assess community response:

Predicted Impact From Increase Over Existing Noise Levels

Increase in Levels	Assessment	Expected Response
Less than 6 dBA	No Impact	Little comment or individual reaction
6 to 14 dBA	Some Impact	Some individual comment and reaction, no group action is likely
More than 14 dBA	Gret Impact	Strong individual comment and group action

Using the above criteria, it is shown that project-generated traffic noise will have "no impact" in terms of the L_{dn} levels, but will have "some impact" in terms of the L_{eq} values for the peak hour arena traffic levels.

2. Arena Sound Impacts

The preliminary site plan for Site C shows an arena with a floor area of approximately 175,000 sq. ft. With a floor-to-ceiling height of 40-50 feet, the total volume of the arena would be in the range of 7,000,000 to 8,750,000 cu. ft. Arenas of this size fall into the "large" category, and require large speaker systems capable of handling several thousand watts of audio power. Typical audience area levels of 110 dBA will be created at times. Thus, a potential for disturbance will exist in the areas surrounding the arena.

With a closed arena design, most of the sounds created inside the arena will be confined. However, depending on the type of material used for the different building components and the design, some types of buildings will be more sound attenuating than others. For example, if a pneumatic structure utilizing a flexible outer skin supported by air is used as the roof assembly, sound insertion losses of 25 to 30 dB are attainable, depending on the fabric. Various types of coated fabrics with weights ranging from 400 to 3,700 grams per sq. meter will yield sound attenuation of 25 to 30 dB at 500 Hertz sound frequencies. An arena roof of fixed or movable design of solid construction would reduce noise by approximately 30 dB or more for surface weights of 1.0 lb. per sq. ft. or more. With these types of roofs and with wall structures having minimum surface weights of 1.0 lb. per sq. ft. or more, the arena interior sound levels of 110 dBA would be reduced to 80-85 dBA in the near field and to 60-65 dBA at 500 foot distances (the approximate distance to the mobile home park directly west of Zanker Road).

Thus, the interior-to-exterior noise levels at the mobile home park will be below the maximum levels for existing traffic and therefore, would not create any significant impact to nearby residents.

3. Construction Phase Impacts

During the construction phase of the project, high noise levels in the site vicinity may temporarily be created. The site preparation and construction phases will generate sound levels ranging from approximatley 70 to 90 dBA at 50 foot distances from heavy equipment and vehicles. The construction vehicles and equipment generally are diesel powered and produce a characteristic noise which is primarily concentrated in the lower frequencies. Engine noise typically predominates, but additional noise originates from fans and transmission systems.

The total noise energy impacting a receptor point is dependent on the work phases of the construction process, on the distance, and on the angle subtended by the work processes at the noise receptor locations.

The powered equipment and vehicles act as point sources of sound which will diminish with distance over open terrain at the rate of 6 dBA for each doubling of the distance from the source. For example, the 70 to 90 dBA equipment peak noise range at 50 feet will reduce to 64 to 84 dBA at 100 feet, and from 58 to 78 dBA at 200 feet. Noise levels experienced at the project boundary depend on where construction occurs on the site.

B. Impacts on the Arena

The arena would be subject to noise impacts from traffic sources on Zanker Road and SR 237. The existing exterior noise levels are 59 and 66 dB L_{dn} along Zanker Road and SR 237, respectively. Future Year 2000 noise levels will be 65 and 68 dB L_{dn} for Zanker Road and SR 237, respectively. Thus, the levels at the site are over the City of San Jose exterior standard for Public and Quasi-Public uses. These standards require interior noise levels to be reduced to 45 dB L_{dn}. Thus, the arena building shell would need to provide 23 dB of noise reduction to meet this standard. With the building shell constructions described in Section II-A-2 above, the arena would provide, as a minimum, 25 dB of reduction. Therefore, mitigation measures will not be necessary to meet the standard provided that the building shell is designed to include the recommendations given in Section III below, and is constructed properly.

III. Mitigation Measures

A. Project-Generated Noise

1. Traffic Noise Impacts

Based on the criteria for assessment of impacts, project-generated traffic noise will have "no impact" in terms of the 24 hour noise level (L_{dn}), but may cause "some impact" when peak arena traffic noise levels are considered. The most significant impacts from project-generated traffic noise will be at the mobile home park across Zanker Road from the arena site.

Noise level impacts on existing agricultural and industrial uses will be insignificant. Therefore, to shield the mobile home park residents from excessive noise, the following measures are recommended.

To reduce the 66 dB L_{dn} at the mobile home park to the San Jose standard of 60 dB L_{dn}, the following barrier is required:

- Construct a 6 ft. high acoustically-effective wall or fence along the property line of the mobile home park bordering Zanker Road. Flanking barriers of 6 ft. height must extend along the north and south property lines for 250 ft. west from the main barrier.

To shield the mobile home park from the high late night L_{eq} levels created by project-generated traffic, the following barrier is recommended:

- Construct a 10 ft. high barrier along the mobile home park property line bordering Zanker Road. Flanking barrier segments must extend along the north and south property lines for a distance of 111 ft. west of the main barrier at a 10 ft. height, then reduce to 6 ft. in height for an additional distance of 467 ft.

If a 6 ft. high barrier is selected, it can be constructed of any solid material with a minimum surface weight of 1.5 lbs. per sq. ft. If the 10 ft. high barrier is constructed, it must have a minimum surface weight of 4 lbs. per sq. foot. The barrier heights are in reference to the grade elevation of Zanker Road.

2. Arena Noise Emission Mitigation

Noise impacts generated from within the arena, i.e., crowds, loudspeaker systems, and other sources, will vary in intensity depending on the type of roof used for the structure. Thus, with building constructions described in Section II-A-2, sounds emanating from the arena will not be significant, and additional mitigation measures will not be required. However, it is recommended that any openings in the arena structure, such as windows, ventilation shafts, or skylights, be designed as controlable openings, so that they may be kept closed during periods when the arena is in use, and interior-to-exterior sound transmission be kept to a minimum.

B. Mitigation of Noise Impacts on the Arena

The following measures are recommended to insure adequate noise control for the arena:

- The arena should be designed to achieve a minimum building shell insertion loss of Sound Transmission Class (STC) 23. This rating applies to the roof, walls, windows, doors and all other building shell elements providing a barrier for exterior-to-interior noise transmission.

- No permanent, significant openings should be included between the exterior and interior seating spaces. Thus, some form of mechanical ventilation should be provided. Windows, which may be operable, and doors should provide the STC 23 rating in the

closed position. These elements should be maintained closed when the arena is in use. Vestibules may be used for doors requiring more direct access to the exterior.

C. Construction Noise Mitigation

Mitigation of the construction phase noise at the site can be accomplished by using quiet or "new technology" equipment. the greatest potential for noise abatement of current equipment is the quieting of exhaust noises by use of improved mufflers. Therefore, it is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer. In addition, all equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engine, drive-train and other components.

In addition to the source emission controls, mitigation of construction noise can also be achieved by:

- Scheduling noisy operations for the daytime hours of 7:00 a.m. to 7:00 p.m. to avoid the more noise-sensitive evening and nighttime hours.

A noise reduction benefit can also be achieved by appropriate selection of equipment utilized for various operations, subject to equipment availability and cost considerations. Noise levels should be a consideration in the selection of construction equipment and methods.

The above report presents our noise study findings and recommendations for the planned arena, Site "C", in San Jose. The study findings for existing traffic conditions are based on field measurements and other data and are correct to the best of our knowledge. The future noise level predictions are based on information provided by the traffic consultant, and Cal Trans. Significant deviations in the predicted traffic volumes or future changes in motor vehicle technology, noise regulations or roadway configurations may produce long-range noise results different from our estimates.

If any additional information or an elaboration of this report is required, please call me.

Respectfully submitted,

Edward L Pack

Edward L. Pack, Sc.D.,P.E.
Principal Acoustical Engineer

ELP:m

Attachment: Appendix A: References
Appendix B: Noise Standards, Terminology, and Acoustical Instrumentation

APPENDIX A

References:

(a) Site Plan, Site C, Phase One, by Sink Combs Dethlefs, Denver, Colorado, undated

(b) Information on Existing, Future, and Project-Generated Traffic Volumes Provided by Barton-Aschman Associates, by Transmittal to Edward L. Pack Associates, Inc., July 1987

(c) Highway Research Board, "Highway Noise, A Design Guide for Highway Engineers", Report 117, 1971

(d) Information on the General Plan Designations for the Site Provided by Peter Frey, City of San Jose Planning Department, by Telecon to Edward L. Pack Associates, Inc., July 28, 1987

(e) Noise Element of the General Plan, Horizon 2000, City of San Jose, Adopted by City Council, November 1984

APPENDIX B

Noise Standards, Terminology and Instrumentation

1. Noise Standards

A. San Jose Noise Element

The San Jose Noise Element uses the day-night level (L_{dn}) noise descriptor to quantify community noise environments. The standards regarding Public, Quasi-Public and Residential Land Uses (including arenas and parks), specify an exterior L_{dn} of up to 60 dB as "satisfactory". An exterior level of 60 to 70 dB L_{dn} indicates an acoustical analysis should be performed to reduce interior noise to acceptable levels, and outdoor activity is limited to acoustically protected areas. Above 70 dB L_{dn}, new development is permitted only if the use is entirely indoors, and if building design limits interior noise to acceptable levels.

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the Community Noise Analyzer. Some of the statistical levels used to describe community noise are defined as follows:

L_{10} - A noise level exceeded for 10% of the time, considered to be an "intrusive" level.

L_{50} - The noise level exceeded 50% of the time, representing an "average" sound level.

L_{90} - The noise level exceeded 90% of the time, designated as a "background" noise level.

L_{eq} - The continuous-equivalent level is that level of a steady noise having the same energy as a given time-varying noise. The L_{eq} thus represents the decibel level of the time-averaged value of sound energy or sound pressure squared. The L_{eq} is the noise descriptor used to calculate the L_{dn} and CNEL descriptors.

B. Day-Night Sound Level (L_{dn})

Noise levels utilized in the standards are described in terms of the day-night sound level (L_{dn}). The L_{dn} rating is determined by the cumulative noise exposures occurring over a 24 hour day in terms of A-weighted sound energy. The 24 hour day is divided into two subperiods for the L_{dn} index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m., and the nighttime period from 10:00 p.m. to 7:00 a.m. A 10 dBA weighting factor is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The L_{dn} is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$L_{dn} = [(L_d + 10 \log_{10} 15) \,\&\, (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24$$

where:

$L_d = L_{eq}$ for the daytime (7:00 a.m. to 10:00 p.m.)
$L_n = L_{eq}$ for the nighttime (10:00 p.m. to 7:00 a.m.)
24 indicates the 24 hour period
& denotes decibel addition

C. Community Noise Equivalent Level (CNEL)

The CNEL is a measure of the cumulative noise exposure over a 24 hour period. The CNEL index divides the 24 hour day into three subperiods, i.e., the daytime (7:00 a.m. to 7:00 p.m.), the evening (7:00 p.m. to 10:00 p.m.) and the nighttime (10:00 p.m. to 7:00 a.m.), and also applies weighting factors of 5 and 10 dBA to the evening and nighttime periods, respectively, to account for the greater sensitivity of people to noise during those periods. The CNEL values are calculated from the measured L_{eq} values in accordance with the following mathematical formula:

$$CNEL = [(L_d + 10 \log_{10} 12) \ \& \ (L_e + 5 + 10 \log_{10} 3) \ \& \ (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24$$

where:

$L_d = L_{eq}$ for the daytime (7:00 a.m. to 7:00 p.m.)
$L_e = L_{eq}$ for the evening (7:00 p.m. to 10:00 p.m.)
$L_n = L_{eq}$ for the nighttime (10:00 p.m. to 7:00 a.m.)
24 indicates the 24 hour period
& denotes decibel addition

D. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighting network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of a Gen Rad Company Community Noise Analyzer, which provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the analyzer was provided by a microphone extended to a height of 5 ft. above the ground. The "A" weighting network and the "Fast" response setting of the analyzer were used in conformance with the applicable standards. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

APPENDIX C-4

GEOTECHNICAL ANALYSIS

EARTH SYSYTEMS CONSULTANTS

PALO ALTO, CALIFORNIA

SAN JOSE ARENA FACILITY EIR

AUGUST, 1987

GEOTECHNICAL REPORT

PROPOSED SAN JOSE ARENA - SITE C

San Jose, California

Prepared for

DAVID J. POWERS & ASSOCIATES

San Jose, California

By

EARTH SYSTEMS CONSULTANTS
1900 Embarcadero Road
Palo Alto, California

JULY 1987

Earth Systems Consultants

GEOTECHNICAL ENGINEERING • ENGINEERING GEOLOGY • ENVIRONMENTAL GEOLOGY

File No. C6-2280-C1
July 20, 1987

Mr. David J. Powers
David J. Powers & Associates
1885 The Alameda, Suite 210
San Jose, California 95126

Subject: Proposed San Jose Arena - Site C
San Jose, California
GEOTECHNICAL REPORT

Gentlemen:

We are pleased to submit the enclosed report which presents the findings of our geotechnical study and evaluation of Site C. Site C is one of three sites in San Jose that is being considered as a possible location for the proposed multi-purpose civic arena.

Our report concludes that from a geotechnical point of view, this site is considered suitable for the proposed development. The geologic conditions that would impact upon the project are identified and evaluated in the report. The enclosed recommendations outline measures that could be implemented to mitigate those conditions that were identified as having a potentially adverse impact upon the development. The report also includes recommendations concerning which types of foundations would be suitable for an arena built on this site.

It was a pleasure to work with you on this most interesting project. If you have any further questions please do not hesitate to contact our office. This report completes our current assignment on this project.

Very truly yours,

EARTH SYSTEMS CONSULTANTS

Bruce O'Neill

Bruce O'Neill, Project Engineer

Reviewed by:

Murray Levish, C.E.G. 194

John P. Nielsen, C.E. 16113

BON/ML/JPN:tm

Copies: 2 to David J. Powers & Associates

CONTENTS PAGE NO.

CONTENTS - continued PAGE NO.

GEOTECHNICAL REPORT

SUBJECT: PROPOSED SAN JOSE ARENA - SITE C
SAN JOSE, CALIFORNIA

CLIENT: DAVID J. POWERS & ASSOCIATES

INTRODUCTION

There is a proposal for a 20,000 seat multi-purpose arena to built in San Jose. Three possible sites for the arena are currently being studied: Site A, Site B and Site C. This Geotechnical Report presents the results of our geotechnical evaluation of Site C. Site C is located at the southeast corner of State Highway 237 and Zanker Road in northern San Jose (see Figure 1, page 4). The site is bounded on the east by Coyote Creek and on the south by undeveloped land. The evaluations of Sites A and B are presented in separate reports.

Proposed Development

If the arena is built on Site C, it is currently proposed that it will be located at the southeast corner of Highway 237 and Zanker Road (see Figure 2, page 5). The Project Architect, Sink Combs Dethlefs, has indicated that the arena will be a predominantly concrete structure with metal framing supporting the roof and will be approximately 350 by 450 feet long. The heavy, unitized concourse portion of this structure is expected to be a relatively rigid body that will respond to movement as a unit, whereas the metal framed roof is a

relatively flexible structure. This combination of structural elements should produce a structure that is relatively insensitive to differential settlement of the supporting soil. It is anticipated that the arena will be built at the existing ground level without a basement, and that the foundation loads will be concentrated near the perimeter of the building. Preliminary estimates made by the Project Structural Engineer indicate that each column will carry approximately 250 kips.

Surface parking will be provided around the arena. The existing county bus maintenance facility will remain on the site in its present location (see Figure 2).

Purpose and Scope

The purpose of this study was to determine and evaluate the geologic and seismic conditions at this site; to evaluate the behavior of the soils under earthquake-induced vibrations and under the loading imposed by the proposed arena; and to assess the suitability of the proposed site with regard to the construction of an arena facility.

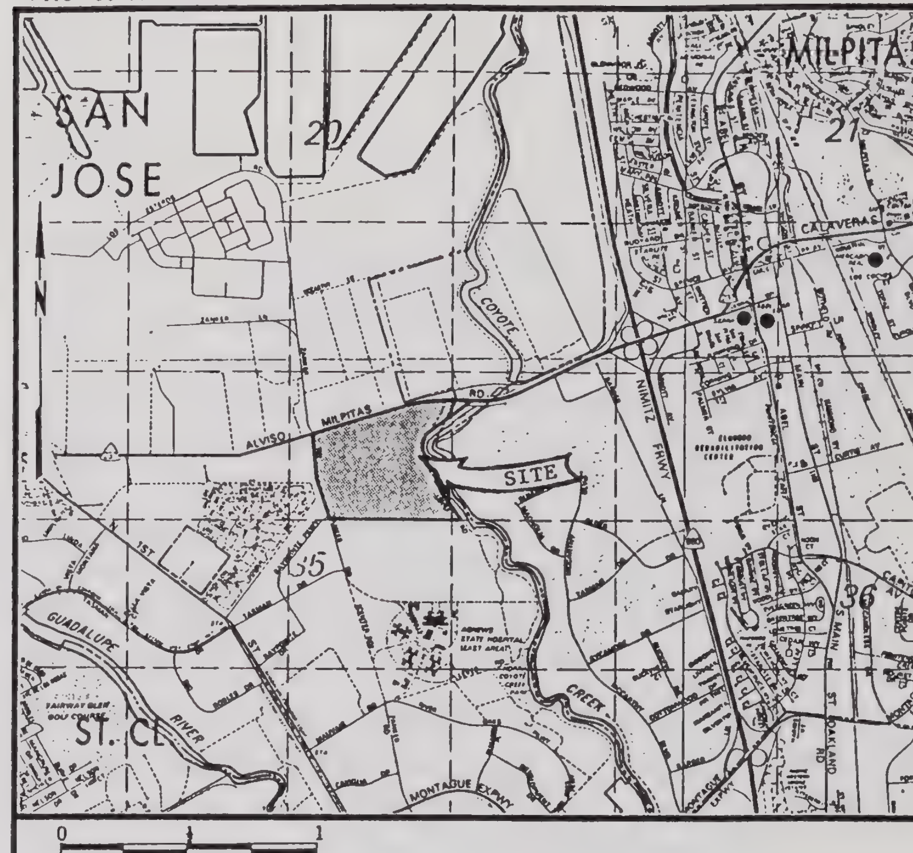
This study included a review of pertinent geotechnical literature and maps; execution of five cone penetrometer probes; drilling and sampling from three exploratory borings; laboratory testing of some of the retrieved samples; analysis of the data obtained by these programs; and the preparation of this report.

Conclusions presented in this report are based on the data acquired and analyzed during this study. This report is intended to be an addendum to the Environmental Impact Report being prepared for the project and should be used for planning purposes only. Further detailed site investigation and data analysis will be required in order to develop specific foundation recommendations and soil design parameters.

Site Description

Site C is relatively level, and is approximately 10 to 15 feet above the level of the bed of the adjacent Coyote Creek. The northern portion of the site is currently occupied by the County bus maintenance facility, parking and a storage yard. The southern portion of the site is an undeveloped field with a major gas transmission line running through the property.

The banks of Coyote Creek are unrestrained along this section of the creek except where the creek passes under Highway 237. The channel is unlined and the banks have slopes that vary from approximately 1:1 to 2½:1 (horizontal to vertical).



LOCATION MAP

Proposed San Jose Arena - Site C
San Jose, California

Base: Thomas Bros. Map Book 40256

Figure 1

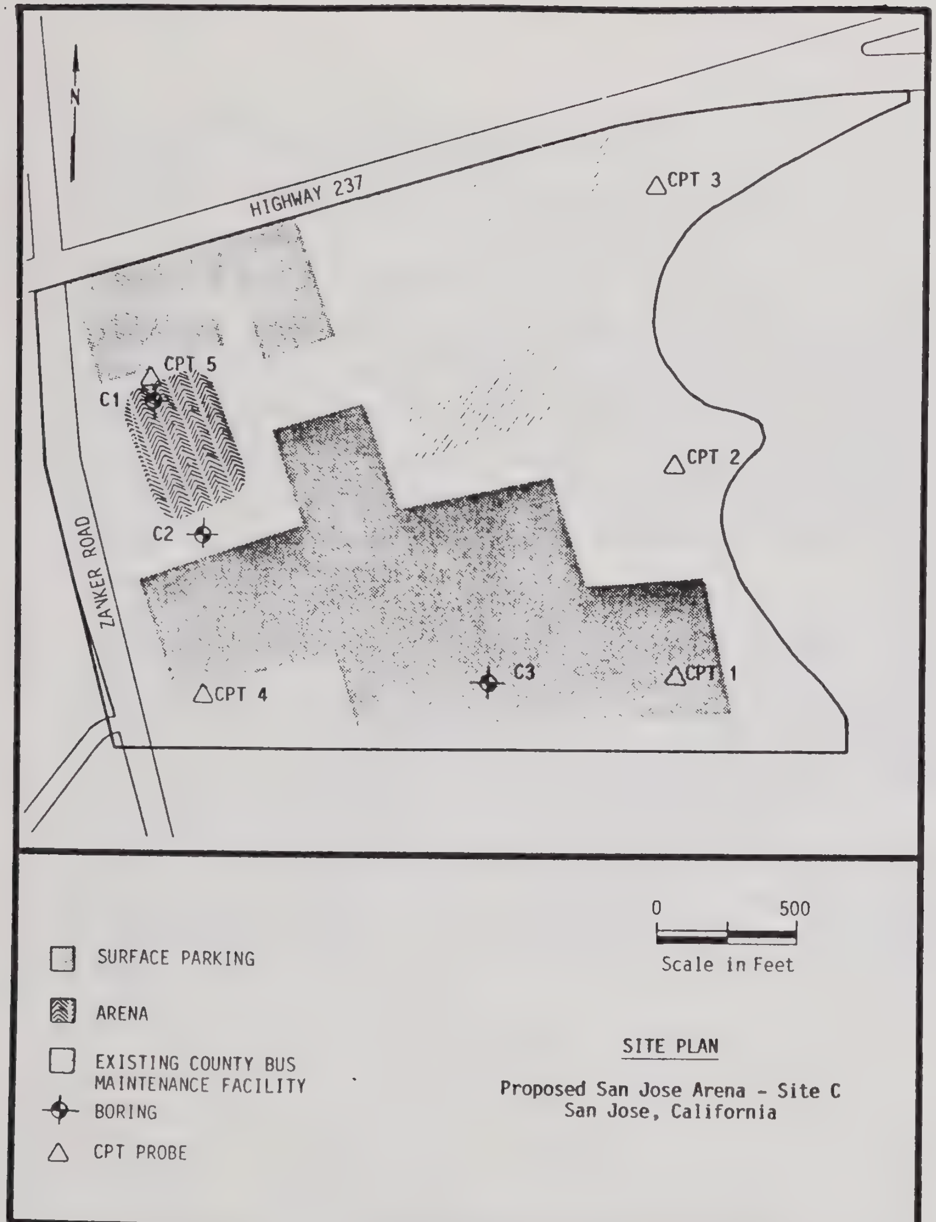


Figure 2

PROCEDURES AND RESULTS

Geologic Setting

Site C is located in the Santa Clara Valley, between the base of the western foothills of the Hamilton-Diablo Mountain Range and the northeastern foothills of the Santa Cruz Mountains in the Coast Range Geomorphic Province of Central California. Bedrock in this area is the Franciscan Complex, a diverse group of igneous, sedimentary and metamorphic rocks of Upper Jurassic to Cretaceous age (70 to 140 million years old). These rocks are part of a northwest-trending belt of material that lies along the east side of the San Andreas Fault system. Geologic cross sections of the area contained in California Department of Water Resources Bulletin No. 118-1 (1975) indicate that the depth to bedrock in this area is in excess of 700 feet.

The Franciscan rocks are overlain, in this area, by marine and non-marine sediments of Cretaceous to Plio-Pleistocene age (80 to 2 million years old), which are, in turn, covered with alluvial, fluvial, lacustrine and bay deposits of Pleistocene to Holocene age (less than 2 million years old).

The regional geology has been mapped by Davis and Jennings (1954), Dibblee (1972), Nilsen (1972), Rogers and Williams (1974), and Helley and Brabb (1971). These maps differ in scale and detail, but they generally agree that the site is underlain at the surface by fine-grained non-marine sediments of undetermined depth. The latter two references describe the materials on the site as fluvial deposits from the edge of young alluvial fans (fine sand, silt and clay).

The U.S. Department of Agriculture (1968) has mapped four agricultural soils on this site. The four soil types generally lay in broad, northwest-trending bands, roughly parallel to Coyote Creek. The Campbell silty clay loam lies on the west side of the site. This soil has an effective depth of 36 to 60 inches and has a moderate shrink/swell potential. The next unit to the east is the Pacheco loam, which has an effective depth of 24 to 48 inches and a moderate shrink/swell potential. The south-central portion of the site is occupied by the Cropley clay loam, which has a depth of 60 inches and a high shrink/swell potential. The remainder of the site is occupied by the Maho loam which has an effective depth of 60 inches and a moderate shrink/swell potential. The distribution of these materials on the site is shown in Figure 3 (page 8).

Cooper-Clark and Associates (1974) report that at the time of that study, this area had subsided approximately 5 feet due to the lowering of the regional groundwater table during this century. They also show that the northwest corner of the site is within an area that may be potentially inundated during unusually high tides. Two-thirds of the site has experienced flooding within historic times. Therefore, fill was placed on portions of the site to raise it above the high water level. The U.S. Geological Survey base map (see Figure 3) shows a bench mark in that corner at an elevation of 12 feet above mean sea level.

0 3000
SCALE IN FEET

SOILS

Proposed San Jose Arena - Site C
San Jose, California

Cc	CAMPBELL SILTY CLAY LOAM
CsA	CROPLEY CLAY LOAM
Mg	MAHO LOAM
Pf	PACHECO LOAM

Figure 3

Seismic Setting

None of the references studied show an active fault on this site. Figure 4 (page 9) shows these faults in the vicinity that have been or are considered active and have previously been or are currently zoned in accordance with the requirements of the Alquist-Priolo Special Studies Zone Act of 1972.

The closest fault to the site is The Silver Creek Fault, which has been mapped approximately 1.2 miles to the east by California Department of Water Resources (1963), and beneath this site by Cooper-Clark (1974). Davis and Jennings (1954), and Rogers and Williams (1974) show the Silver Creek Fault to end at the north end of Silver Creek Canyon, about 8 miles southeast of the site.

Jennings (1975) shows the Silver Creek to be a "Quaternary" fault, or one that has displayed movement between 200 and 2,000,000 years ago. United Soil Engineering (1978) indicates that the youngest sediments affected by the Silver Creek Fault are 500,000 years old. The Silver Creek has been designated as a potentially active fault by Cooper-Clark and Associates (1974) and the Santa Clara County Planning Department (1975). Helley and Brabb (1971) show undisturbed Quaternary sediments in the valley across the projected trace of the Silver Creek Fault. The portion of the Silver Creek Fault near this site is not and has never been zoned under the provisions of the Alquist-Priolo Act.

0 5
Scale in Miles

ARENA SITE

ACTIVE FAULT

POTENTIALLY ACTIVE FAULT

EARTHQUAKE EPICENTERS OF MAGNITUDE 0.5 OR GREATER (1969-1970)

REGIONAL FAULT MAP

Proposed San Jose Arena
Sites A, B and C
San Jose, California

Compiled from Brown & Lee, 1971; Rogers & Williams, 1974; and California Division of Mines and Geology, 1982

Figure 4

The Crosley Fault has been mapped along the base of the hills, approximately 3.3 miles northeast of the site (Rogers and Williams, 1974; Dibblee, 1972). This fault has been classified as potentially active by Rogers and Williams (1974) and by the Santa Clara County Planning Department (1975). Jennings (1975) shows it to be a "Quaternary" Fault, or one that has moved between 200 and 2,000,000 years ago. This fault does not appear on the maps by Crittenden (1951), Davis and Jennings (1954) nor Brown and Lee (1971). Dibblee (1973) was the first to map a continuous fault along the base of the hills in eastern San Jose. This exposure was surveyed and confirmed by Burkland and Associates during a study of the Minoli property, south of Crosley Creek (Burkland and Associates, 1977b).

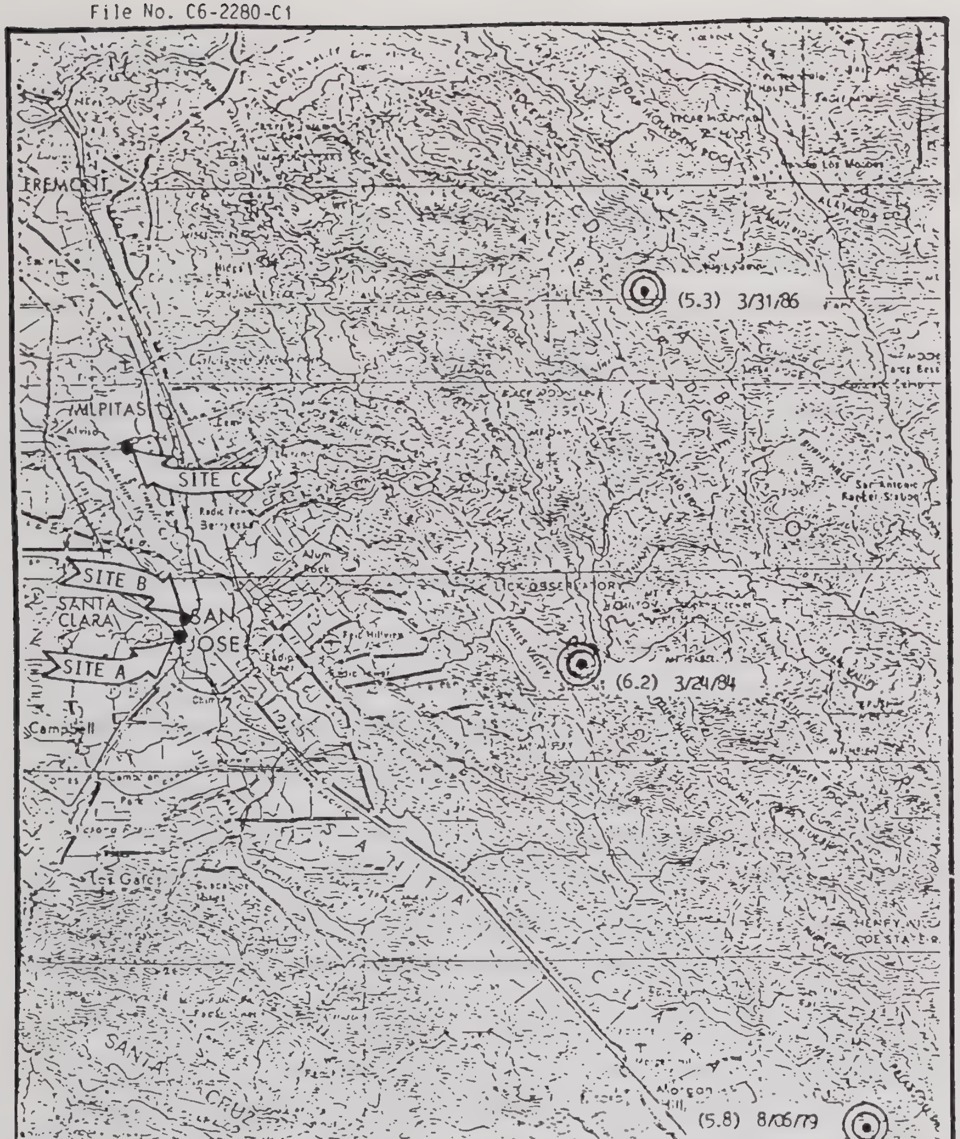
Studies done along the Crosley Fault (Burkland and Associates, 1977a,b,c,d; 1978a,b,c; and Earth Systems Consultants, 1978, 1983, 1986) have shown it to be an active reverse fault with a variable dip to the east. Dibblee (1972) and others show the Crosley to be part of the Hayward Fault system.

The Hayward is an active fault and has been mapped approximately 3.7 miles northeast of the site (Dibblee, 1972; Rogers and Williams, 1974; California Division of Mines and Geology, 1982). This fault is known to be creeping northwest of the site in Fremont. Ground rupture occurred along parts of the Hayward Fault from Warm Springs northward during the earthquakes of 1836 and 1868 (Radbruch-Hall, 1974).

The Sargent-Berrocal Fault has been mapped 10.5 miles southwest of this site. This section of that fault is considered to be potentially active.

The Calaveras Fault, 6.6 miles northeast of the site, and the Hayward Fault, are both part of the regional San Andreas Fault system. The main trace of the San Andreas Fault is located about 13.5 miles southwest of the site in the Santa Cruz Mountains. The Crosley, Hayward, Calaveras and San Andreas Faults have been zoned by the California Division of Mines and Geology (1982).

A number of major earthquakes are known to have occurred in the vicinity of the site. The October 8, 1865 earthquake (estimated Richter magnitude 6.5) was centered on the San Andreas Fault, approximately 14 miles west of the site. The epicenter of the October 21, 1868 event (estimated Richter magnitude 7.0) has been located at a point approximately 7 miles northwest of the site on a branch of the Hayward Fault. The epicenter of the earthquake of April 18, 1906 (Richter magnitude 8.3), originally plotted in Olema, Marin County, has been relocated to a point in northern San Mateo County, approximately 33 miles northwest of the site (Real et al., 1978). The July 1, 1911 earthquake (estimated Richter magnitude 6.6) is plotted as having occurred approximately 16 miles southeast of the site. The location of that epicenter is uncertain and it has not been ascribed to movement on any particular fault. The 1979 Coyote Lake (Richter magnitude 5.8), and the 1984 Halls Valley (Richter magnitude 6.2) earthquakes were centered on the Calaveras fault approximately 31 and 16 miles southeast of the site. The 1986 earthquake near Mt. Lewis (Richter magnitude 5.3) was centered approximately 17 miles northeast of the site and was not ascribed to a known fault (see Figure 5, page 13).



0 5
Scale in Miles
(5.3) Richter Magnitude

LOCATION OF RECENT NEARBY
MAJOR EARTHQUAKE EPICENTERS

Proposed San Jose Arena Sites A, B and C
San Jose, California

Figure 5

During the earthquake of April 18, 1906, various forms of ground failure were reported in the vicinity of the subject site. The failures reported were concentrated along Coyote Creek and consisted of ground settlement, lateral spreading, stream bank failures, extensively fissured ground, and sand boils (Youd and House, 1978). Ground shaking also caused significant damage to brick structures approximately 1/2-mile south of this site.

The "northern bridge" over Coyote Creek, as described by Lawson (1908) is assumed to be the structure at the northeast corner of this site, where Highway 237 crosses the creek. This is confirmed by Youd and Hoose (1978). The supports of that bridge were displaced in 1906. At the Boot Ranch house, 1500 to 2000 feet west of the bridge, water and sand erupted from the ground, which then settled 11 inches. Lurch cracking and lateral spreading were reported from various locations along Coyote Creek in Milpitas. The prolonged sand boil activity that was observed was probably the venting of artesian pressure through a lurch crack. Elevated groundwater and sand boil activity continued in an area west of the creek, 150 feet north of the bridge, for two days following the earthquake.

The Agnews State Hospital, approximately 1/2-mile southwest of the site also sustained major damage. All the brick buildings at the hospital were damaged beyond repair and 112 people were killed. Roofs collapsed, and the tower of the administration building fell inward. Much of this damage was attributed to poor construction.

Rogers and Williams (1974) classify the site according to its seismic hazard potential. Most of the site lies within their zone D1-2, which includes areas

in which the groundwater table is 10 to 20 feet below the surface. The southwest corner is in zone D1-1, in which groundwater is less than 10 feet down. Both of these zones are classified as having a high potential for seismically-induced liquefaction, lateral spreading and lurch cracking.

Cooper-Clark and Associates (1974) have also divided the site into hazard zones. The entire site is shown as having a high liquefaction potential. In addition, the southwest corner of the site has a moderately low potential for seismically-induced lateral ground movement and a moderately high potential for vertical movement. The banks and bed of Coyote Creek have a high potential for both lateral and vertical movement.

The map prepared for use in preparing the Santa Clara County Seismic Safety Plan (Seed, 1974) places this site in the category "Possible Liquefaction, Requires Investigation." This map indicates that the estimated characteristic period of the soil deposit is between 1.5 to 2.2 seconds.

Soil reports for two nearby projects were in the files of the City of San Jose Building Department. Terratech did a study at this site in October 976 for the bus maintenance facility. Applied Soil Mechanics prepared a report in 1984 for the business park located at Zanker and Tasman.

However, Terratech's boring logs show layers of sand up to 10 feet thick, found between 21 and 28 feet deep. There are no blow count values for most of the layers, however there is a 2.5-foot layer of sand with only 10 blows per foot in Boring No. 4 at 24 feet. This loose layer lying below the water table shows a potential for strength loss in the case of an earthquake.

Applied Soil Mechanics stated that there was a low to moderate potential for seismically induced strength loss. Sand layers were encountered during drilling and sampling, but Applied Soil Mechanics concluded that there was sufficient clay binder and fine gravel in the soil that strength loss would be inhibited. Also, a fairly uniform layer of cohesive soils, 18 to 20 feet thick, lies above the sand layers which reduces the possibility of strength loss in an earthquake. The logs show layers of sand at depths of 12 to 20 feet and below the water table. Logs 1, 2, 3, 6 and 7 reveal sand layers with low blow counts (greater than 14 blows per foot). These are potentially weak layers.

Terratech did not address this problem in their study.

Subsurface Exploration

The subsurface exploration program at this site consisted of two phases; cone penetration testing and exploratory drilling. The locations of the probes and borings were distributed to cover the entire site with a concentration around the proposed location of the arena. The approximate locations of the probes and borings are shown on Figure 2.

Cone Penetration Testing

An electronic cone penetrometer (CPT) was used to probe the site in five locations on May 18, 1987. The probes ranged in depth from 60 to 80 feet. Information derived from the cone probes included a continuous profile of site stratigraphy, and correlations with various soil strength parameters.

A CPT is a 1.4-inch diameter steel cone which is instrumented to record the bearing pressure on the tip of the cone (tip resistance), the friction along a 4-inch long segment of the probe (local friction), and the pore water pressure behind the tip of the cone. Plots of the tip resistance, the local friction, the friction ratio (local friction/tip resistance), the pore pressure and the differential pore pressure ratio (measured pore pressure minus hydrostatic pore pressure all divided by tip resistance) are presented in Appendix A. The cone measures these values continuously and records a set of measurements every 2 inches. The cone is pushed into the ground with a hydraulic press which is mounted on a conventional drill rig truck.

Based on empirical correlations, the parameters measured by the cone penetrometer can be used to infer the soil type, the relative density of the soil, the angle of internal friction, the equivalent N value (standard penetration test blow count), the cyclic stress ratio, and the undrained shear strength of the soil. The validity of empirical correlations is greatly enhanced when confirmed with local experience. For that reason, an exploratory boring was placed adjacent to CPT Probe 5. The interpretations of these parameters based on the empirical correlations have been computerized. Due to the volume of output accumulated, the processed data is not enclosed in this report. The data is stored in the files of Earth Systems Consultants, and is available upon request. Included with the other plots of the cone data are interpreted plots showing the generalized stratigraphy, and some of the relevant soil properties as derived from the empirical correlations.

Drilling and Sampling

The second phase of the subsurface exploration program consisted of the drilling and sampling of three test borings on May 26, 1987. One boring was placed adjacent to the location of CPT Probe 5 to aid in developing on-site correlations between the CPT data, the visual classification of the material, and the soil parameters measured in the laboratory. The other borings were spaced across the site to aid in developing information relative to the site profile and the general subsurface soil and geologic units. The borings were advanced with a truck-mounted drill rig equipped with 8-inch diameter, hollow stem, continuous flight augers. Boring depths ranged from 40 to 43½ feet below the existing ground surface. According to the Santa Clara Valley Water District exploratory borings placed below 45 feet require special measures to seal the boreholes to prevent possible cross contamination of water aquifers. In the site selection phase of the geotechnical evaluation we were requested by Mr. David J. Powers not to complicate the investigation in that manner, thus boring depths were restricted to 45 feet during this phase of the investigation.

Each boring was visually logged in the field by a field engineer. Relatively undisturbed samples were obtained by using a 3-inch O.D. Modified California Sampler lined with 2½-inch O.D. by 6-inch-long brass tubes. The sampler was driven 18 inches into the soil using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final 12 inches are recorded on the boring logs, which are

presented in Appendix A. Pocket penetrometer tests were run to develop an initial estimate of the variation of shear strength with depth. The stratification lines on the boring logs represent approximate boundaries between soil types, but the actual transition may be gradational.

Laboratory Testing

The laboratory testing program was directed toward determining some of the physical and engineering properties of the soils on the site and developing local correlations with the CPT output. The results of the laboratory tests are presented in Appendix B.

Strength parameters of selected samples were determined by means of direct shear tests run on "undisturbed" samples. The samples were soaked for 24 hours prior to shearing. The direct shear tests were run at a constant rate of strain on unconsolidated samples that were free to drain. Strength parameters of selected samples of the cohesive soils were determined by means of unconfined compression tests.

A consolidation test was run on a representative clay sample to determine the compressibility of the material. Sieve analyses and hydrometer analyses were performed on selected samples of the non-cohesive material to determine the grain size distribution. Moisture/density tests were run on those samples not otherwise selected for testing.

Soils and Subsurface Materials

There are six major material types that were identified during the field investigation. The soil profile at this site was formed by a variety of geologic activities and as a result is variable across the site. The thickness and depth below the surface of the different layers vary from location to location.

Unit 1: The uppermost unit at this site appears to be a fill consisting of yellow brown silty clay and sandy silt. This material was described in the field as damp, stiff to very stiff, and having a low plasticity. Encountered in all the borings, this material was about 3 feet thick.

Unit 2: In Boring 1, the material below the miscellaneous fill was an orange brown sandy clay. This material was moist, stiff, and had a low plasticity. In Boring 1, this type of material was found at a depth of 2 to 8 feet and again at 15 to 19 feet. In the other borings, this type of material was found between 11 and 14 feet. This indicates that the material in Boring 1 between 2 and 8 feet is probably fill that was borrowed from somewhere else on this site. This is in accordance with the fact that we know portions of the site were raised during development to prevent flooding of the Bus Maintenance facility.

Unit 3: Below the fill in all three borings was a highly plastic, dark grey to olive brown silty clay. This soil was moist and stiff to hard. It was found at a depth of 8 to 15 feet in Boring 1, 3 to 9 and 13 to 23 feet in Boring 2, and 3 to 12 feet in Boring 3.

Unit 4: Below the highly plastic clay, granular material was encountered in each of the three borings. This material consisted of predominantly tan or grey-brown silty sands, mixed with some sandy silts with clay. These material were all saturated. In Boring 1, this material was found at a depth of 19 to 35 feet, in Boring 2 at 23 to 38 feet, and in Boring 3 from 14 feet to the bottom of the hole at 43½ feet.

Unit 5: In Borings 1 and 2 an orange silty clay with sand is located beneath the granular material. This material is moist, stiff to hard and has a low plasticity.

Unit 6: Dense sands and gravels were encountered at a depth of approximately 75 feet in CPT Probe 2 and 49 feet in CPT Probe 4. This material was approximately 3 feet thick at CPT Probe 4, and was not penetrated at CPT Probe 2.

Groundwater

The groundwater level was determined during the field exploration program to vary from between 4 to 15 feet below the ground surface. The groundwater level was visible in three of the borings and was determined during two of the CPT probes by pausing and allowing the excess pore pressures generated by the probe to dissipate.

Boring / CPT Probe	Depth Below Ground Surface
Boring 1	15 feet
Boring 2	10 to 14 feet
Boring 3	11 to 14 feet
CPT Probe 1	Not determined
CPT Probe 2	4 feet
CPT Probe 3	Not determined
CPT Probe 4	10½ feet
CPT Probe 5	Not determined

This indicates that if the arena is to be constructed with a basement, dewatering will probably be required during construction. The presence of a high groundwater table is a factor that should be addressed when designing the basement. Note that these measurements were taken in late May, 1987. The rainfall during the previous winter was below average, and the groundwater level during construction may be higher.

Response of the Soils to Seismic Loading

Some of the soils at this site may liquefy when subjected to seismic loading. Liquefaction is a phenomenon that occurs when saturated, loose, granular soils are subjected to strong ground shaking. Under these conditions, the granular soils will attempt to densify, resulting in the development of excess pore pressures which impedes densification. If the pore pressures cannot dissipate as rapidly as they are generated, the soil may then behave like a heavy, viscous fluid. Under these conditions, the soil will loose shear strength, and if the imposed shear stresses (due to structural loading, or the presence of a nearby slope) exceed the soil strength, the "liquified" soil will "flow." This can cause slope or foundation failures. Where the soil is confined or there are no imposed shear stresses, no movement occurs except for some possible areal or local settlement.

If the soils are only partially saturated, there is no impedance to densification, and as a result local and/or areal settlement occurs.

The susceptibility of the soils to liquefy depends on the degree of shaking to which they are subjected, the density of the soils, the amount of fine grained material in the soil, the confining pressure (the depth below the ground surface), and the degree of saturation.

The potential ground shaking at this site was estimated using the methods suggested by Seed and Idriss (1982). The site is located 3.7 miles from the Hayward Fault (maximum probable earthquake M = 7.0), and 13.5 miles from the San Andreas Fault (maximum probable earthquake M = 8.3). It is estimated that the maximum probable earthquake on the Hayward Fault would cause 10 to 15 cycles of significant shear stress at this site, with a maximum ground acceleration of 0.28g. Significant shear stress is defined as two-thirds the maximum shear stress developed during the earthquake. It is estimated that the maximum probable earthquake on the San Andreas Fault would cause 20 to 25 cycles of significant stress with a maximum ground acceleration of 0.24g.

Most, if not all of the potentially liquefiable soils at this site appear to be saturated. This is important because saturated soils liquefy much easier than partially saturated materials. Partially saturated soils may densify under cyclic loading leading to settlement, but are less prone to a reduction in shear strength.

Liquefaction is primarily confined to granular soils with a clay content of less than 15 percent. Sieve analyses and hydrometer analyses of several of the materials suspected of being susceptible to liquefaction were performed in the laboratory to determine their grain size distribution. The results of

these tests which are presented in Appendix B confirmed the field classification of the material and indicated that they have an insufficient percentage of fine grained material to provide internal cohesion and prevent liquefaction.

Cyclic shear stress ratios (shear stress/confining pressure) are an indication of the susceptibility of a soil to liquefy. Our estimate of the cyclic stress ratios required to cause the soil to liquefy were derived from correlations with the CPT data and are based on work by Robertson and Campanella (1986). Layers where a potential problem exists were identified by comparing the potential cyclic shear stresses that could be generated by the maximum probable earthquake with the cyclic stress ratios that would cause the soil to liquefy.

The following table shows the location of the layers of potentially liquefiable soils identified at this site.

Boring / CPT Probe	Depth to Potentially Liquefiable Soil
Boring 1	20 to 36 feet
Boring 2	23 to 38 feet
Boring 3	14 to 43½ feet
CPT Probe 1	No liquefiable soils encountered
CPT Probe 2	72 to 75 feet
CPT Probe 3	No liquefiable soils encountered
CPT Probe 4	30 to 31, 37 to 39 feet
CPT Probe 5	27 to 34 feet

Note that the CPT data indicates that there is less potentially liquefiable soil at this site than is indicated by the data obtained from the boring logs. Cone penetrometers work efficiently and continuously in loose granular

materials providing an evaluation of the different horizons within a soil unit. Data from boring logs is not continuous, and is compromised by the difficulty involved in obtaining samples in saturated, loose, granular soils.

Historic evidence indicates that lateral spreading, slumping along the stream banks, lurch cracking, and areal settlement can be expected in this area. The potentially liquefiable soils near the arena are confined with a cap of 20 to 23 feet of non-liquefiable materials, and it is not anticipated that cracking will extend through this material. Therefore, sand boils and the local settlements that result when these occur would not be expected to occur in the area slated for development. The historic evidence also indicates that these problems would be more severe near the eastern portion of the site, where no development is proposed.

Response of the Site Soils to Loads Imposed by the Structures

Compressibility

If the arena is supported on a shallow foundation the primary response of the site soils to the loads imposed by the arena will be to compress and cause settlement. The compressible soils that will have the most impact on this project are the Unit 2 and 3 materials. In Borings 1 and 2 which are in the immediate vicinity of the proposed location, there is a nearly uniform thickness of 20 feet of compressible material above the granular material.

Initial estimates of the settlement and differential settlement that would occur indicate that they would be within tolerable limits for this type of structure provided that the foundation acted as a unit.

Materials Able to Support Deep Foundations

CPT Probe 2 indicates that there is a dense layer of granular material underlying a portion of this site at a depth of approximately 75 feet below the existing ground surface. This layer of material would probably provide excellent bearing capacity for deep end-bearing piles. A more comprehensive field investigation program would be required to identify the extent and thickness of this layer before deep end-bearing foundations could be considered for this site.

Suitable Foundation Types

Suitable foundation types for the major and minor structures on this site are discussed below. Suitable foundations must be able to sustain seismic loading, settlement due to consolidation of the underlying soils, possible areal settlement of the underlying soils during an earthquake, and the loads imposed by the proposed structure. In order to provide soil design parameters, additional site investigation work will be required.

a. Piles

Driven piles could be used to construct suitable foundations for the structures on this site. The piles could be designed to develop bearing capacity with skin friction or perhaps by end-bearing on the dense sands and gravels found below this site in CPT Probe 2 at a depth of 75 feet. Further exploration would be required to determine if this layer of material was continuous across the site. Dense intermediate level soil layers that may increase the difficulty of driving piles to the bearing

layer were encountered in CPT Probes 1 and 4 at depths of between 27 to 38 feet. It may be possible to pre-drill holes through these layers, and then drive piles in these holes down to the bearing stratum.

b. Drilled Piers

If drilled piers are used at this site, it is expected that the pier holes will need to be cased to prevent collapsing, and that drilling mud may be required to prevent the saturated silty sands from flowing into the bottom of the pier hole. Unless specific structures or installations, that are susceptible to vibrations caused by pile driving, are identified in the vicinity of the arena, drilled piers appear to be a less suitable foundation than driven piles.

c. Mat Foundation

From a geotechnical engineering viewpoint, a unitized mat foundation would be the most suitable shallow foundation system, for the arena if it is built on this site. The prime advantage of this system is that it would tie the structure together and cause it to respond as a unit to differential settlement of the underlying soils. A mat foundation would also span any localized soft areas.

d. Compensated Foundation

The bearing capacity of a mat foundation could be increased, and the amount of post-construction settlement decreased if a compensated foundation was constructed rather than a mat foundation. A compensated foundation is similar in form to a mat foundation, except that the depth of the foundation is increased. A fully compensated foundation is one

where the weight of the structure matches the weight of the soil that is excavated from the site. The possible depth of a compensated foundation may be restricted at this site by the groundwater level and the need to dewater.

e. Conventional Spread Footings

Conventional spread footings may be suitable for this project if the structure is sufficiently rigid that the footings will be tied together by the structure and will act as a unit and not independently. The differential settlement of the foundations due to consolidation of the upper soils and the possible dynamic consolidation of the granular deposits during an earthquake will probably exceed tolerable limits for independent footings. Unitized, conventional spread footings may be suitable for minor one- or two-story light weight structures such as ticket sales offices, etc.

CONCLUSIONS

The conclusions contained herein are based on the data acquired and analyzed during this study.

General

1. From a geotechnical viewpoint, this site is considered suitable for the proposed development, provided measures are implemented during design and construction of the proposed project, to mitigate the geologic and seismic hazards identified in this report.

2. A moderate to major earthquake on the Hayward, Calaveras or San Andreas, or one of the other active faults in the Bay Area could produce severe ground shaking at this site.

3. There is no evidence indicating that an active fault crosses this site. The evidence that a potentially active fault crosses this site is questionable and not conclusive. The potential for ground rupture to occur is therefore considered to be low.

4. Based on historical records of previous failures, the potential for seismically-induced lateral spreading and landsliding to occur is considered to be moderate to high along the unrestrained portions of the creek bank. These phenomena did occur along the banks of Coyote Creek during the April 18, 1906 earthquake.

5. There are some potentially liquefiable soils underlying the proposed site of the arena. In this portion of the site these materials are found

between a depth of 20 and 38 feet. The liquefiable soil is saturated and is confined with a 20-foot cap of cohesive soil near the arena. It is unlikely that significant local or areal settlements would occur as a result of this material liquefying. Depending on the type and configuration of the foundation, the shear stresses induced in the soil by the structural loads may exceed the strength of the liquefied soil, resulting in a "flow" of the liquefied soil and subsequent foundation settlement or failure. This question will require further analysis or the arena should be founded on piles that penetrate the potentially liquefiable material. Liquefaction or densification of the loose to medium dense granular subsurface materials at this site could result in local or areal settlement, and lateral spreading and slumping along the banks of the river.

6. Structural loads could cause compression of some of the subsurface materials which could result in local settlement.

7. The groundwater table at this site is located approximately 10 to 15 feet below the existing ground surface. There is evidence that there is artesian pressure in some of the soil layers below this site. The level of the groundwater table will probably vary according to the seasonal rainfall. Records of the regional groundwater level indicate that the groundwater level was higher than currently observed, and was lowered during this century by pumping of the groundwater. The groundwater level has increased recently due to a decline in pumping but could be lowered again if pumping was to increase, or raised if pumping was to cease. If an arena is to be constructed with a basement some dewatering may be required during construction.

8. Normal erosion along Coyote Creek will result in the downcutting and gradual widening of the channel, where it is not confined or controlled. Local slumping along the banks is a normal part of this erosion. Loads imposed by structures built near the top of the bank could accelerate this process.

9. The question of whether the soil at this site is contaminated was not within the authorized scope of our work on this project and was not addressed by this study.

10. The suitability of this site for this project relative to the other two sites can be determined by a comparison of the hazards present at each site (see Table I, page 33).

Environmental Impact

11. The construction of an arena at this site would require that significant site grading be done, and that some of the existing utilities be relocated. It should be expected that this type of activity will generate a significant amount of noise at this site, and that construction traffic will generate noise on the access streets to this project as well.

12. Construction traffic poses a potential risk to other vehicles using the streets, will impose significant loads on access streets shortening their life span and necessitating repairs of some of them, and will tend to spread soil into the city streets.

13. Site work will generate dust during the dry summer months. If the construction of this project extends through a winter, the surface runoff water will contain an increased sediment load.

14. The amount of, and impact of noise, traffic, dust, and sediment generated by this project can be minimized by careful planning and construction management.

15. Extensive grading or increased gravity loading along the unsupported creek bank on the east edge of the site could cause failure of that slope. Neither of these activities are included as part of the current site development plan.

16. Paving or construction of buildings over most of the site will limit the ability of precipitation to percolate into the ground and aid in recharging the groundwater supply.

TABLE I

COMPARISON OF THE GEOTECHNICAL CONDITIONS THAT WOULD IMPACT THE PROPOSED ARENA, BY SITE

	SITE A	SITE B	SITE C
SITE SUITABLE FOR PROPOSED DEVELOPMENT	YES	YES	YES
SITE SUBJECT TO STRONG GROUND SHAKING	YES	YES	YES
POTENTIAL FOR GROUND RUPTURE TO OCCUR AT THIS SITE	LOW	LOW	LOW
POTENTIALLY LIQUEFIABLE SOILS IDENTIFIED ON THE SITE	YES	YES	YES
POTENTIALLY LIQUEFIABLE SOILS SHOULD BE ADDRESSED DURING DESIGN	NOT REQUIRED	YES	YES
LATERAL SPREADING AND/OR SLUMPING MAY OCCUR ALONG THE STREAM BANKS THAT COULD AFFECT THE ARENA	NO	YES	NO
POTENTIAL FOR LURCH CRACKING TO OCCUR AT THIS SITE	LOW	LOW	LOW TO MODERATE
REGIONAL GROUNDWATER MEASURED WITHIN 20 FEET OF THE GROUND SURFACE	NO	NO	YES
PERCHED GROUNDWATER MEASURED WITHIN 20 FEET OF THE GROUND SURFACE	YES	YES	NO
COMPRESSIBLE SOILS IDENTIFIED WITHIN THE ZONE OF INFLUENCE OF THE ARENA FOUNDATIONS	YES	YES	YES

RECOMMENDATIONS

General

1. If the proposed arena is constructed with a basement, the design of the basement should incorporate a method of dealing with high groundwater levels.

2. Historical evidence indicates that the banks of Coyote Creek are prone to lateral spreading and landsliding during a seismic event. Structures built in the vicinity of the creek banks should be set back a safe distance, or an engineering solution should be implemented to mitigate the possible effects of an earthquake.

3. Some of the loose, granular soils at this site may be expected to densify when subjected to strong ground shaking. This will result in local or areal settlement of the site. Near the creek, where there is an open exposed face, some of the saturated granular soils may "flow" out of the slope, causing larger settlements near the creek. Structures may be built near the creek bank if measures are implemented to stabilize the banks, otherwise, structures should be set back from the top of the bank.

Further Investigation

4. The discussions in this report regarding site suitability and suitable alternative foundation types are based on the limited site investigation that was described in the body of this report. It is our opinion that this study was comprehensive enough to identify any adverse geotechnical conditions at the site and to determine which types of foundations would be suitable at this

site. Should this site be selected for development, further site investigation will be required in order to provide specific foundation design recommendations.

5. Access to the entire site should be arranged prior to the next stage of site investigation.

6. The structural engineer should be consulted to determine if the characteristic period of the site soils needs to be determined, and if a dynamic analysis of the site soils is warranted.

7. The next phase of this investigation should include a detailed estimate of the expected settlement of the arena. This estimate will require a preliminary layout of the arena columns, and an estimate of their loads. This settlement estimate can be used to determine if a shallow foundation may be an acceptable foundation for the arena.

8. The next phase of this investigation should include a determination of the extent and thickness of the dense sands and gravels underlying this site, to aid in determining whether deep foundations would be suitable for this site.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The conclusions and recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed by the CPT probes or in the exploratory borings. If the actual construction will differ from that planned at the present time, Earth Systems Consultants should be notified to determine whether the conclusions and recommendations enclosed in this report are applicable to the revised project.

2. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes outside of our control. Therefore this report is subject to review by Earth Systems Consultants after a period of three (3) years has elapsed from date of issuance of this report.

3. This report was prepared upon your request for our services, and in accordance with currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

BIBLIOGRAPHY

1. Applied Soil Mechanics, 1984, SOIL INVESTIGATION, LOT 8, NORTH POINTE BUSINESS PARK.

2. Brown, R. D., and W. H. K. Lee, 1971, ACTIVE FAULTS AND PRELIMINARY EARTHQUAKE EPICENTERS IN THE SOUTHERN PART OF THE SAN FRANCISCO BAY REGION (1969-1970), U. S. Geological Survey Basic Data Contribution 30.

3. Burkland and Associates, 1977a, GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, CUNNINGHAM PROPERTY, MILPITAS, CALIFORNIA.

4. Burkland and Associates, 1977b, GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, MINOLI PROPERTY, SAN JOSE, CALIFORNIA.

5. Burkland and Associates, 1977c, PRELIMINARY GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, BERRYESSA CREEK DEVELOPMENT, SAN JOSE, CALIFORNIA.

6. Burkland and Associates, 1977d, GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, LANDS FORMERLY OF WELLER, MILPITAS, CALIFORNIA.

7. Burkland and Associates, 1978a, GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, REBELO PROPERTY, SAN JOSE, CALIFORNIA.

8. Burkland and Associates, 1978b, SUPPLEMENTARY GEOLOGIC INVESTIGATION, BERRYESSA CREEK DEVELOPMENT, SAN JOSE, CALIFORNIA.

9. Burkland and Associates, 1978c, GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, TONELLI PROPERTY, SAN JOSE, CALIFORNIA.

10. California Department of Water Resources, 1963, EVALUATION OF GROUND WATER RESOURCES, SOUTH BAY, California Department of Water Resources Bulletin 118-1, Appendix A.

11. California Division of Mines and Geology, 1982, SPECIAL STUDIES ZONES, CALAVERAS RESERVOIR AND SAN JOSE EAST QUADRANGLES.

12. Cooper-Clark and Associates, 1971, GEOTECHNICAL STUDY OF THE NORTH SAN JOSE AND ALVISO AREA, JOB 743-B.

13. Cooper-Clark and Associates, 1974, GEOTECHNICAL INVESTIGATION, CITY OF SAN JOSE SPHERE OF INFLUENCE, SAN JOSE, CALIFORNIA.

14. Crittenden, M. D., Jr., 1951, GEOLOGY OF THE SAN JOSE-MOUNT HAMILTON AREA, CALIFORNIA, California Division of Mines and Geology Bulletin 157.

15. Davis, F. F., and C. W. Jennings, 1954, MINES AND MINERAL RESOURCES OF SANTA CLARA COUNTY, CALIFORNIA, California Journal of Mines and Geology, Volume 50, No. 2.

BIBLIOGRAPHY

16. Dibblee, T. W., Jr., 1972, PRELIMINARY GEOLOGIC MAP OF THE SAN JOSE EAST QUADRANGLE, U.S. Geologic Survey Open File Report.

17. Dibblee, T. W., Jr., 1973, PRELIMINARY GEOLOGIC MAP, MILPITAS QUADRANGLE, U.S. Geological Survey Open File Report.

18. Earth Systems Consultants, 1978, GEOLOGIC AND SEISMIC HAZARDS INVESTIGATION, LO BUE PROPERTY, SAN JOSE, CALIFORNIA.

19. Earth Systems Consultants, 1983, SUPPLEMENTARY TRENCHING, AMBRA PROPERTY, SAN JOSE, CALIFORNIA.

20. Earth Systems Consultants, 1986, UPDATE OF LANDS OF EVERSON GEOTECHNICAL EVALUATION, MILPITAS, CALIFORNIA.

21. Helley, E. J., and E. E. Brabb, 1971, GEOLOGIC MAP OF LATE CENOZOIC DEPOSITS, SANTA CLARA COUNTY, CALIFORNIA, U. S. Geological Survey Basic Data Contribution 27.

22. Jennings, C. W., 1975, FAULT MAP OF CALIFORNIA, California Division of Mines and Geology, Geologic Data Map Series, Map 1.

23. Lawson, A. C., (ed.) 1908, CALIFORNIA EARTHQUAKE OF APRIL 18, 1906, Carnegie Institute of Washington, D. C.

24. Nilsen, T. H., 1972, PRELIMINARY PHOTO INTERPRETATION MAP OF LANDSLIDES AND OTHER SURFICIAL DEPOSITS, ALAMEDA AND SANTA CLARA COUNTIES, CALIFORNIA, U. S. Geological Survey Basic Data Contribution 40.

25. Radbruch-Hall, D. H., 1974, MAP SHOWING RECENTLY ACTIVE BREAKS ALONG THE HAYWARD FAULT ZONE AND THE SOUTHERN PART OF THE CALAVERAS FAULT ZONE, U.S. Geological Survey Miscellaneous Investigation Map I-813.

26. Real, C. R., et al., 1978, EARTHQUAKE EPICENTER MAP OF CALIFORNIA, California Division of Mines and Geology, Map Sheet 39.

27. Robertson, P. K., and R. G. Campanella, 1986, GUIDELINES FOR USE AND INTERPRETATION OF THE ELECTRONIC CONE PENETRATION TEST, Hogentogler and Company, Gaithersburg, Maryland, 196 pp.

28. Rogers, T. H., and J. W. Williams, 1974, POTENTIAL SEISMIC HAZARDS IN SANTA CLARA COUNTY, CALIFORNIA, California Division of Mines and Geology Special Report 107.

29. San Jose, City of, 1983, FAULT HAZARD MAPS.

30. Santa Clara County Planning Department, 1975, SEISMIC SAFETY PLAN.

BIBLIOGRAPHY

31. Seed, H. B., 1974, UNPUBLISHED MAP PREPARED FOR THE SANTA CLARA COUNTY SEISMIC SAFETY ELEMENT - H. B. Seed Data, October 29, 1974.

32. Seed, H. B., and I. M. Idriss, 1982, GROUND MOTIONS AND SOIL LIQUEFACTION DURING EARTHQUAKES, Earthquake Engineering Research Institute, Berkeley, California, 134 pp.

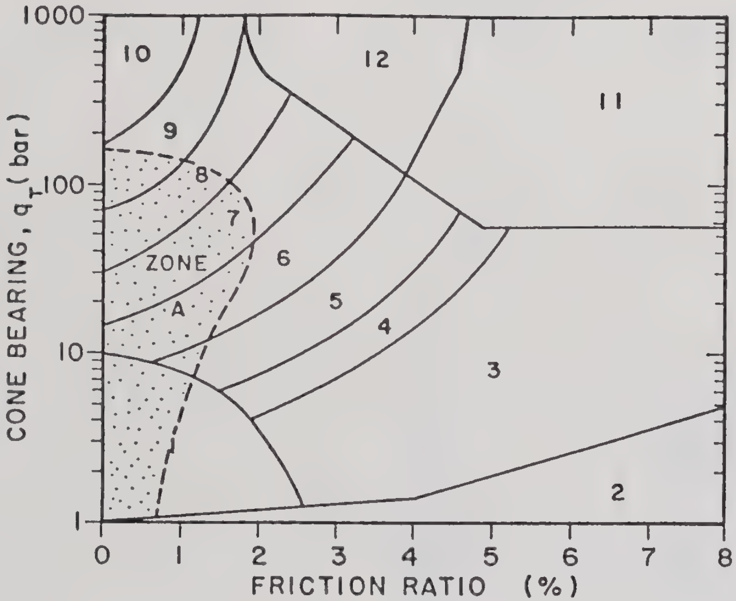
33. Terrasearch, 1976, GEOTECHNICAL ENGINEERING SERVICES REPORT, PROPOSED TRANSIT FACILITIES FOR SANTA CLARA COUNTY - AGNEWS SITE.

34. United Soil Engineering, 1978, GEOLOGICAL REVIEW OF THE SILVER CREEK FAULT TRACE FOR PROPOSED INDUSTRIAL DEVELOPMENT - FUTURE CHARCOT AVENUE.

35. U. S. Department of Agriculture, 1968, SOILS OF SANTA CLARA COUNTY, CALIFORNIA, Soil Conservation Service Publication.

36. Youd, T. L., and S. N. Hoose, 1978, HISTORIC GROUND FAILURES IN NORTHERN CALIFORNIA TRIGGERED BY EARTHQUAKES, U. S. Geology Survey Professional Paper 993.

APPENDIX A



Zone	Soil Behaviour Type
1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained*
12	sand to clayey sand*

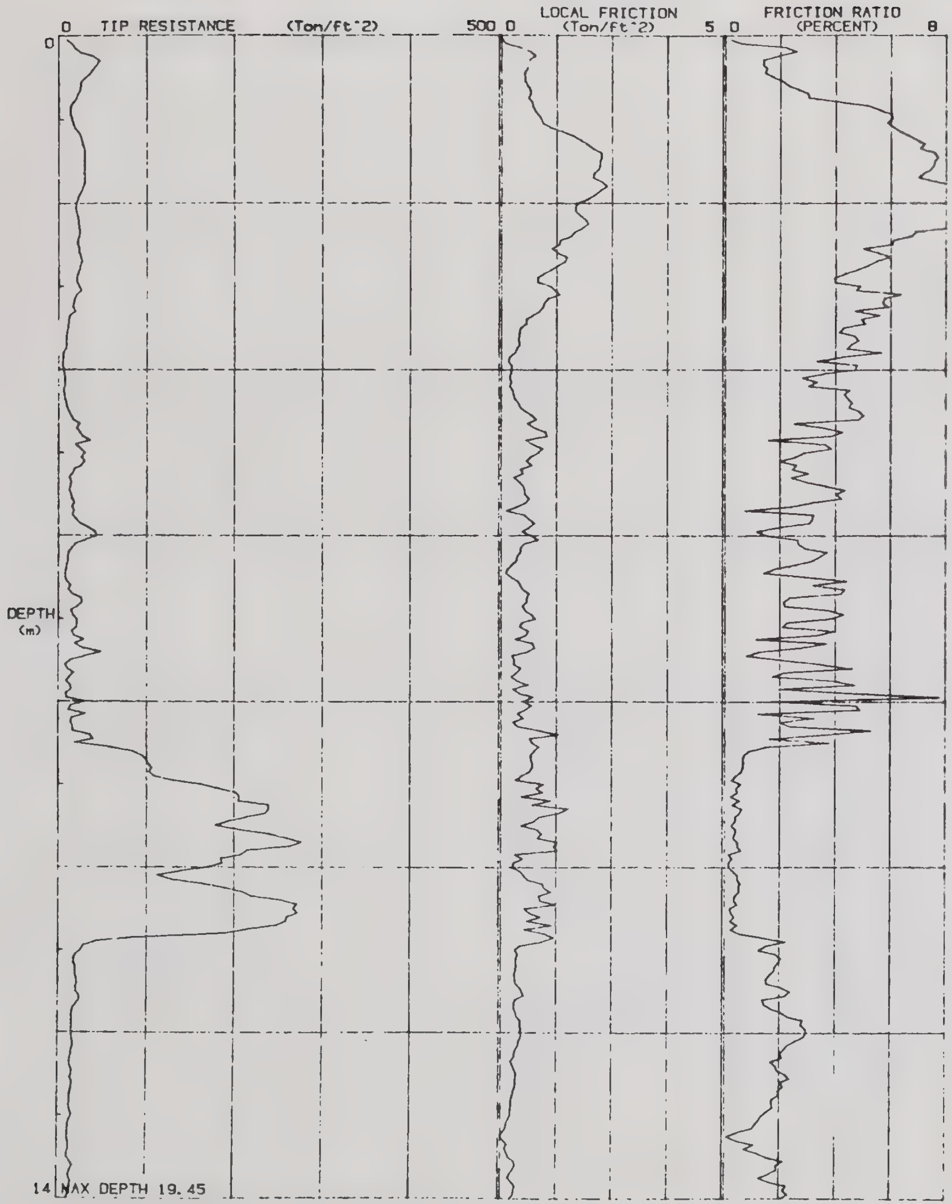
* overconsolidated or cemented.

Materials within Zone A are potentially liquefiable.

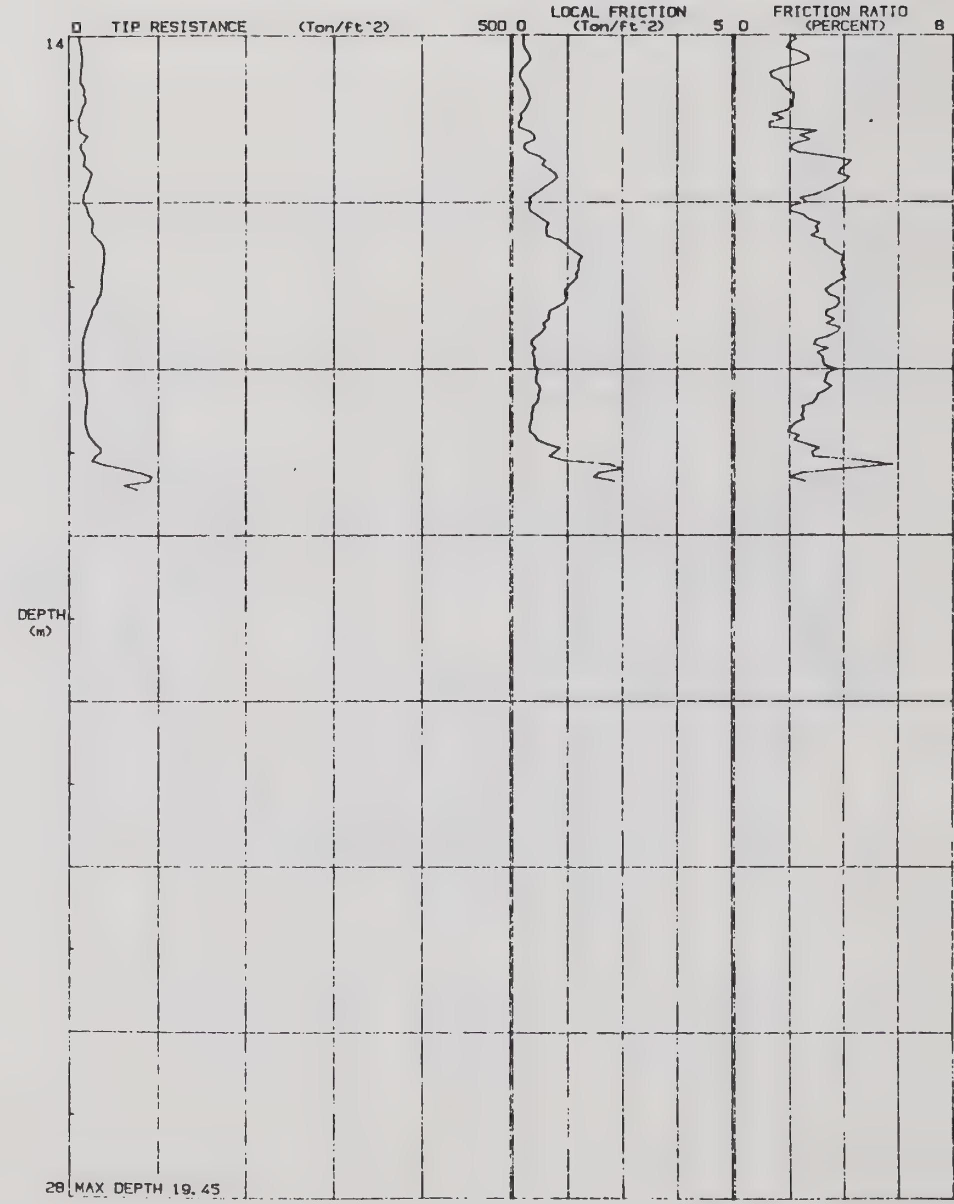
SOIL CLASSIFICATION CHART

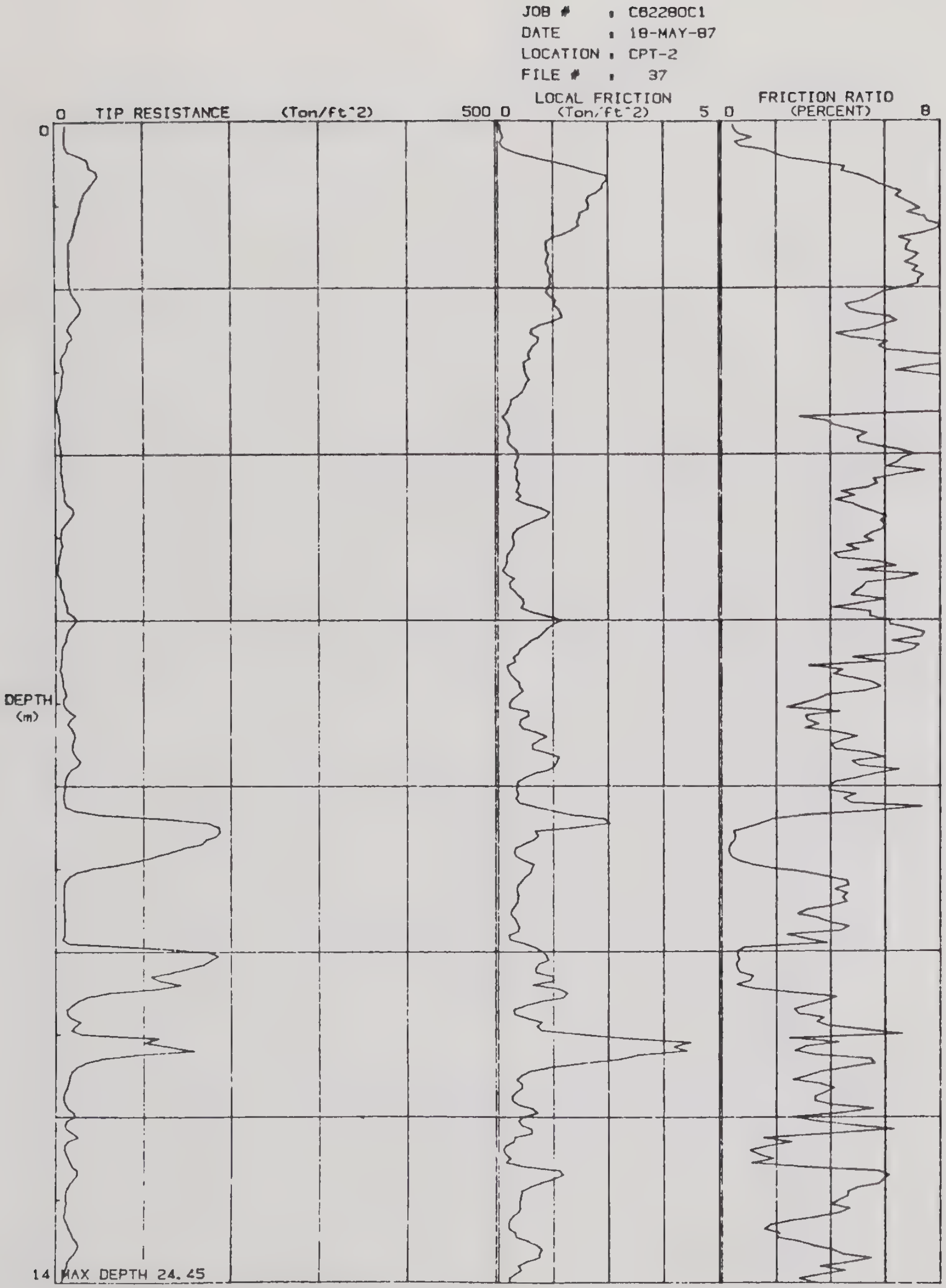
CPT Data: Tip Resistance, Local Friction and Friction Ratio

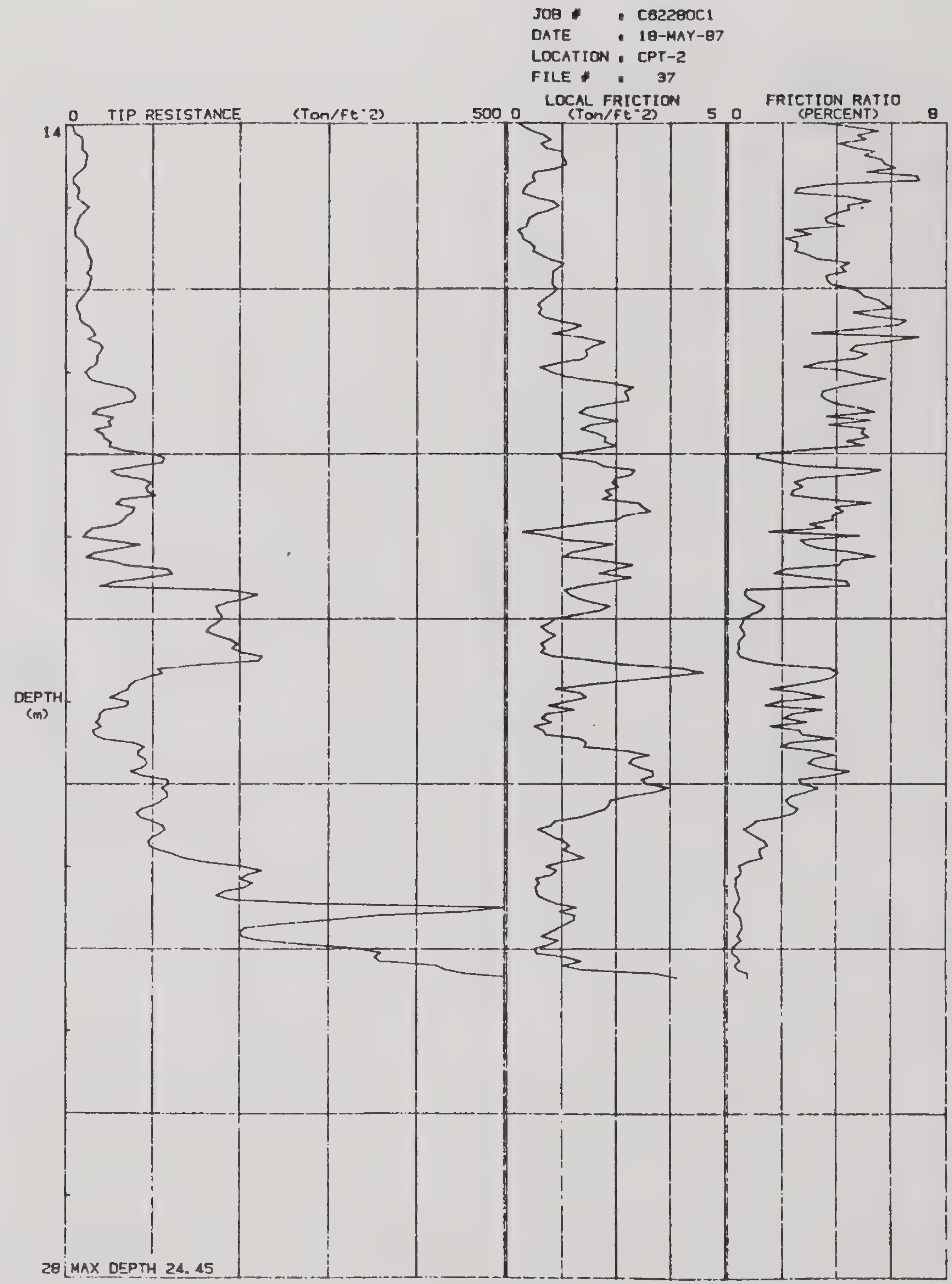
JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-1
FILE # : 38

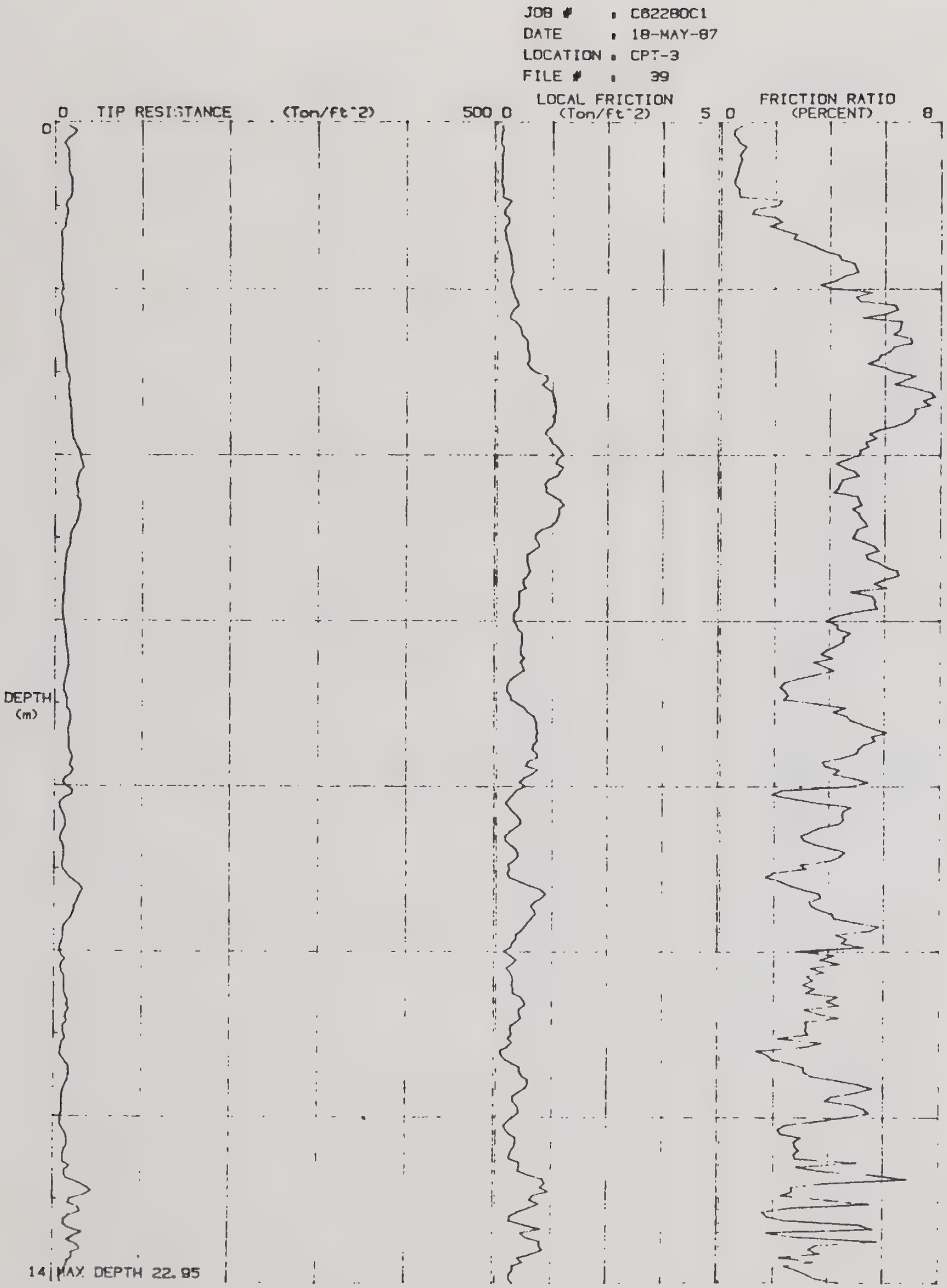


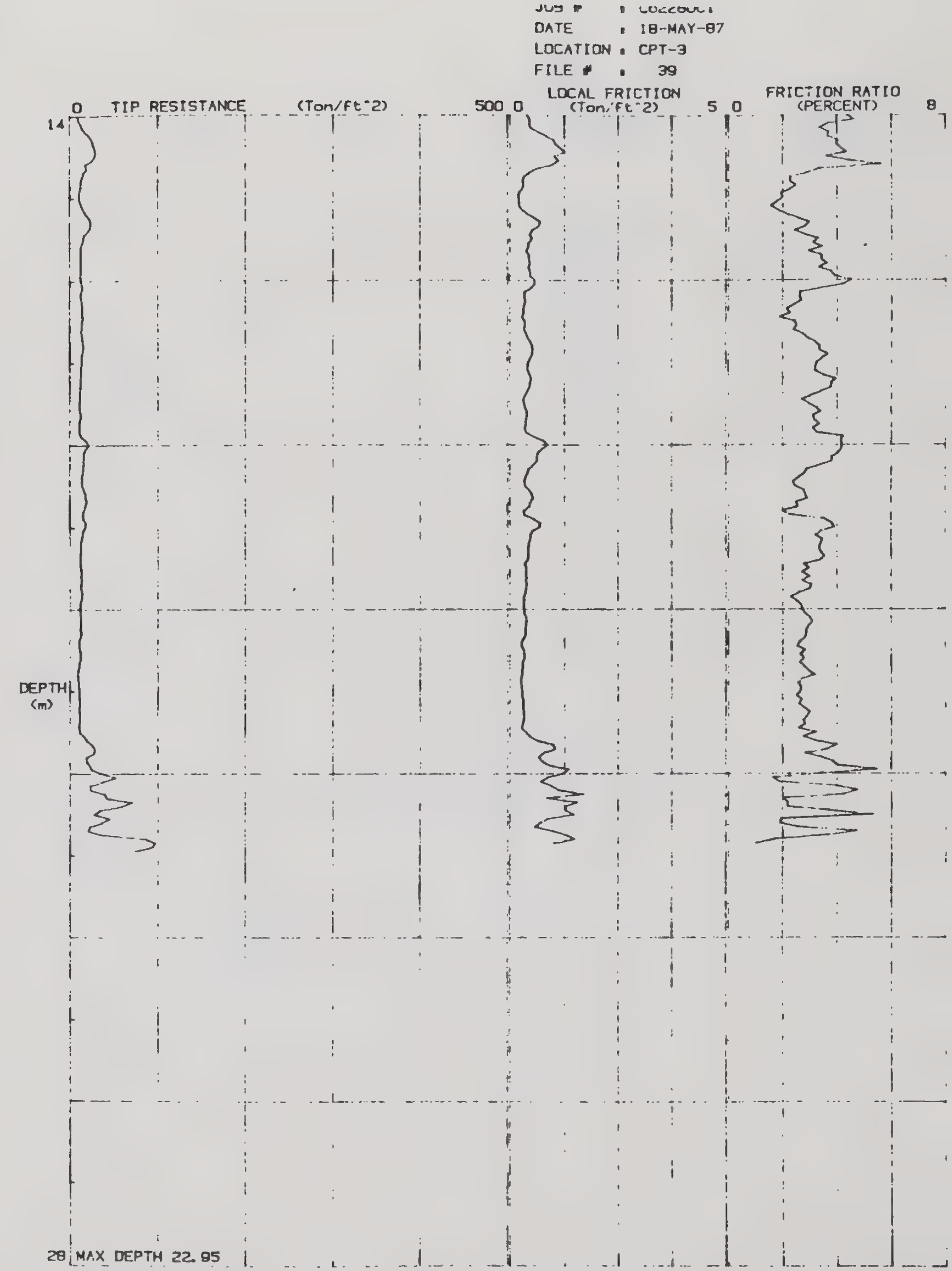
JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-1
FILE # : 38

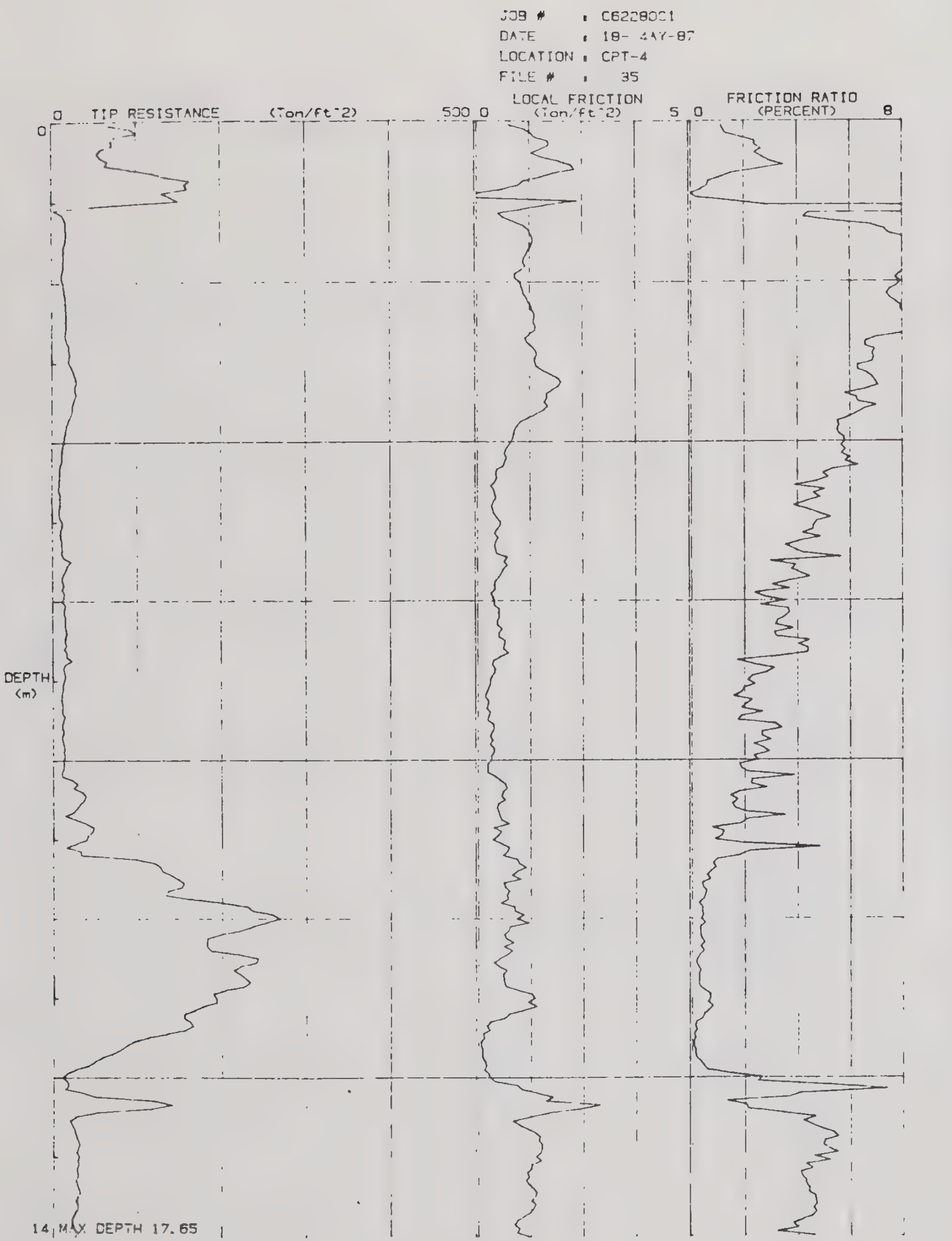


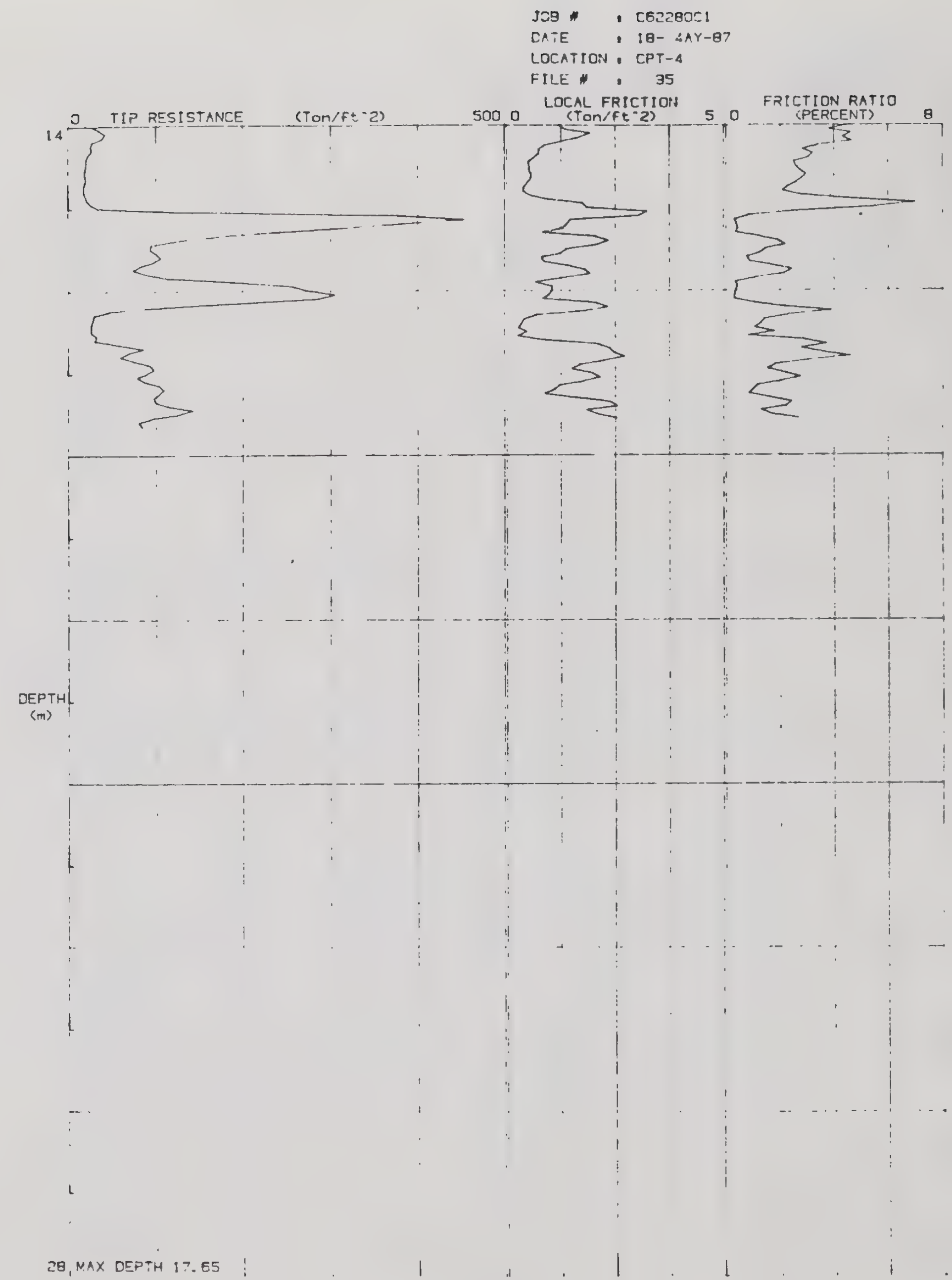

JOB # : C82280C1
DATE : 18-MAY-87
LOCATION : CPT-2
FILE # : 37
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 24.45


JOB # : C82280C1
DATE : 18-MAY-87
LOCATION : CPT-2
FILE # : 37
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 24.45

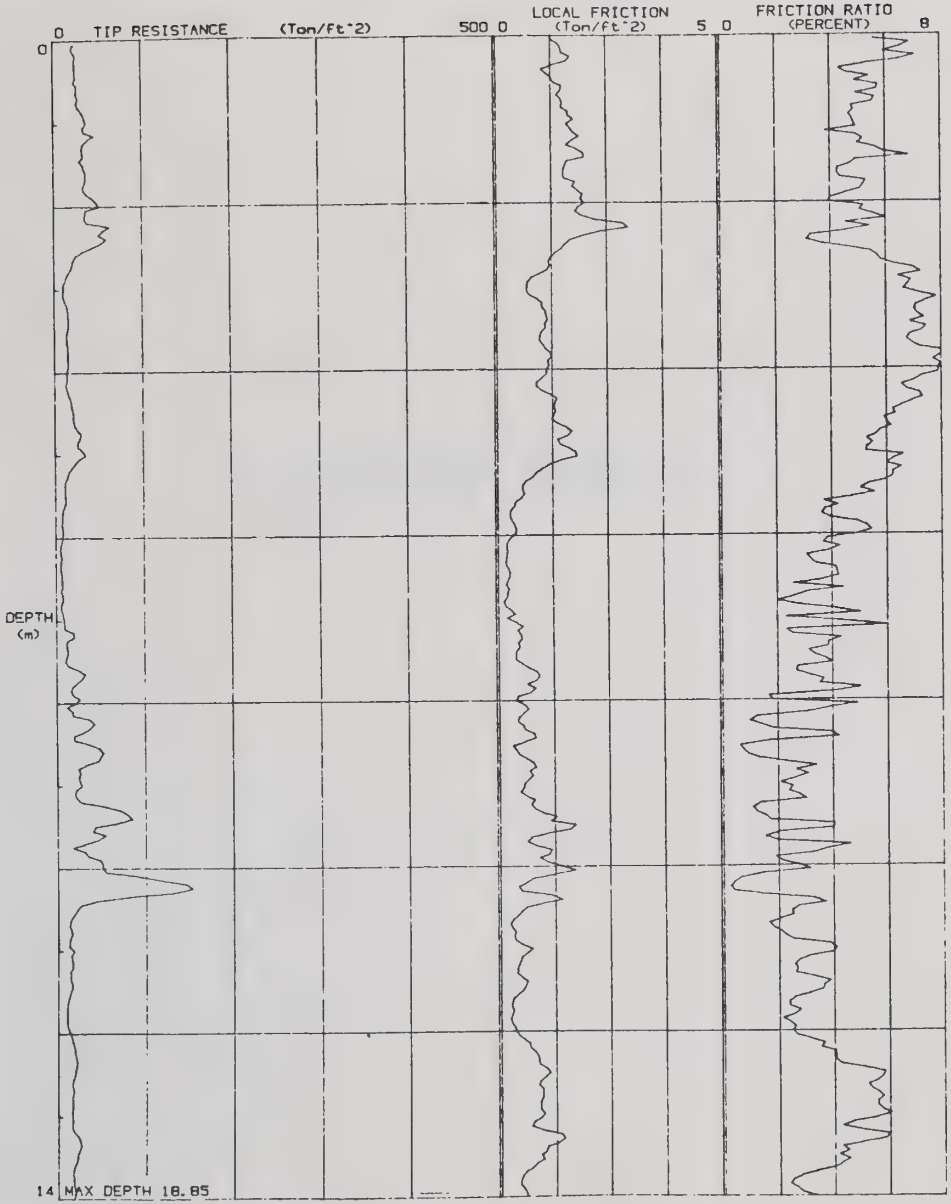

JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-3
FILE # : 39
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
DEPTH (m)
0
14
MAX DEPTH 22.95


DATE : 18-MAY-87
LOCATION : CPT-3
FILE # : 39
0 TIP RESISTANCE (Ton/ft^2) 500
0 LOCAL FRICTION (Ton/ft^2) 5
0 FRICTION RATIO (PERCENT) 8
DEPTH (m)
14
28
MAX DEPTH 22.95

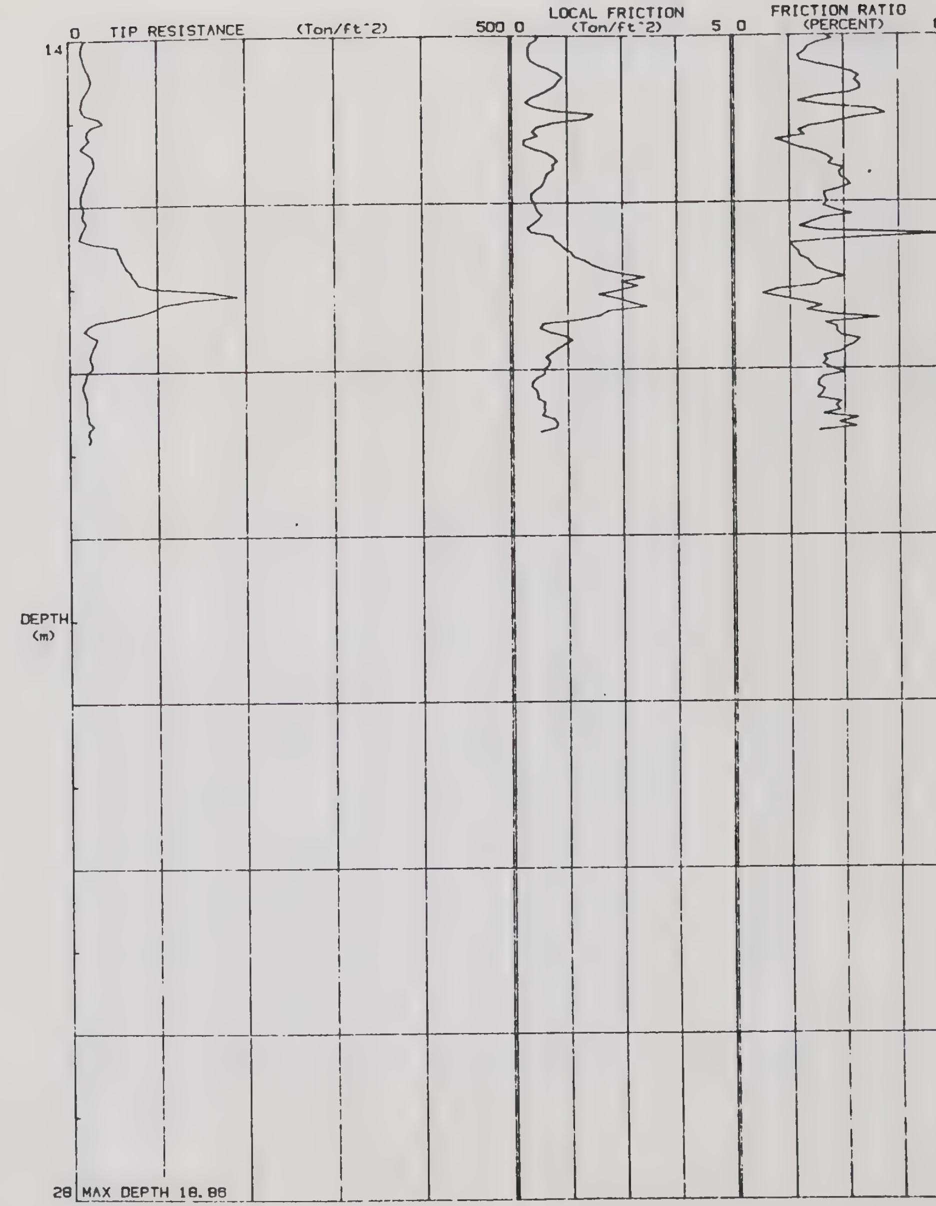

JOB # : C6228001
DATE : 18- MAY-87
LOCATION : CPT-4
FILE # : 35
TIP RESISTANCE (Ton/ft^2)
0
500
LOCAL FRICTION (Ton/ft^2)
0
5
FRICTION RATIO (PERCENT)
0
8
DEPTH (m)
0
14
MAX DEPTH 17.65


JOB # : C6228001
DATE : 18- MAY-87
LOCATION : CPT-4
FILE # : 35
TIP RESISTANCE (Ton/ft^2)
0
500
LOCAL FRICTION (Ton/ft^2)
0
5
FRICTION RATIO (PERCENT)
0
8
DEPTH (m)
14
28
MAX DEPTH 17.65

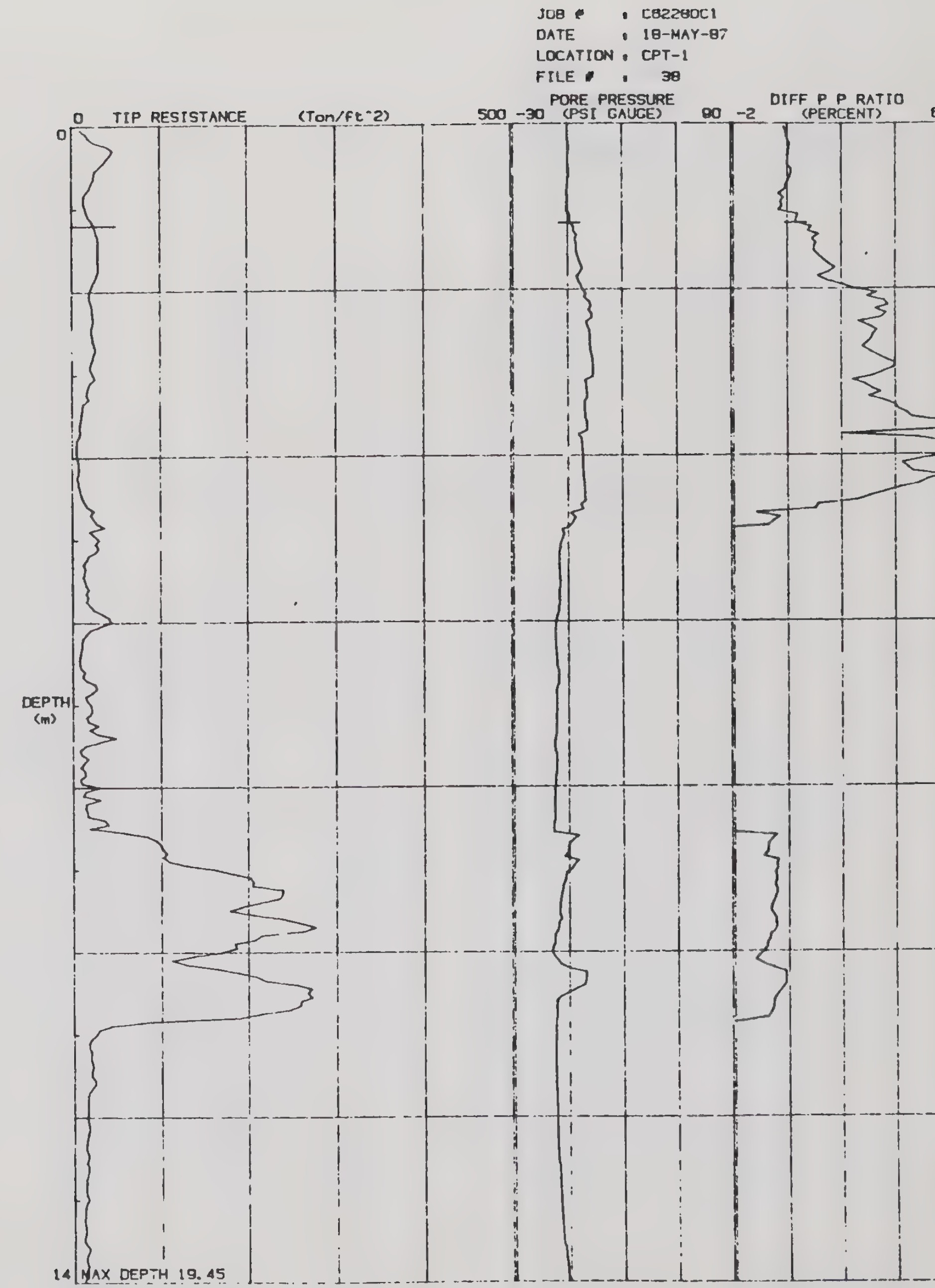
JOB # : nO
DATE : 18-MAY-87
LOCATION : CPT-5
FILE # : 38

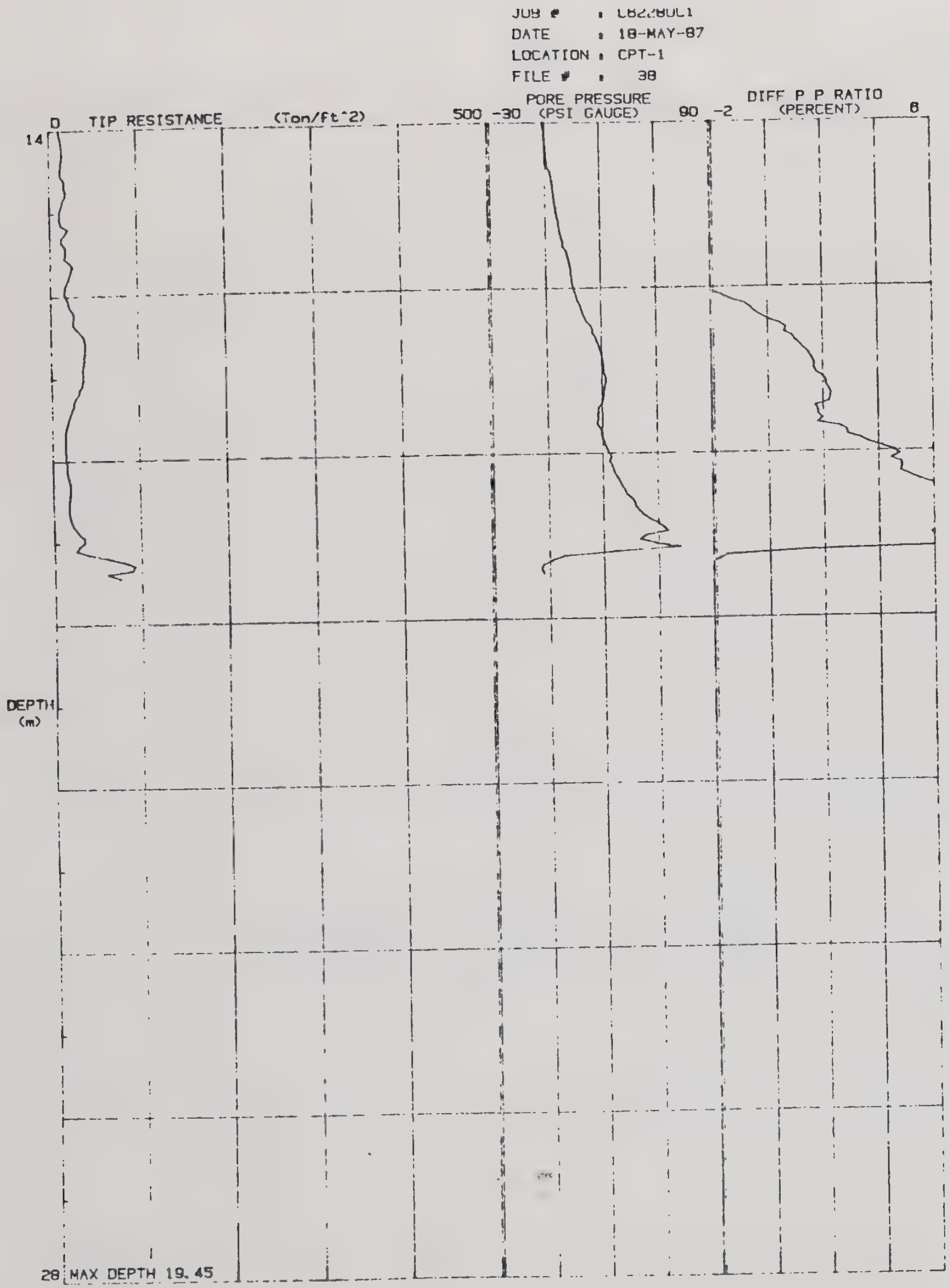


JOB # : nO
DATE : 18-MAY-87
LOCATION : CPT-5
FILE # : 38

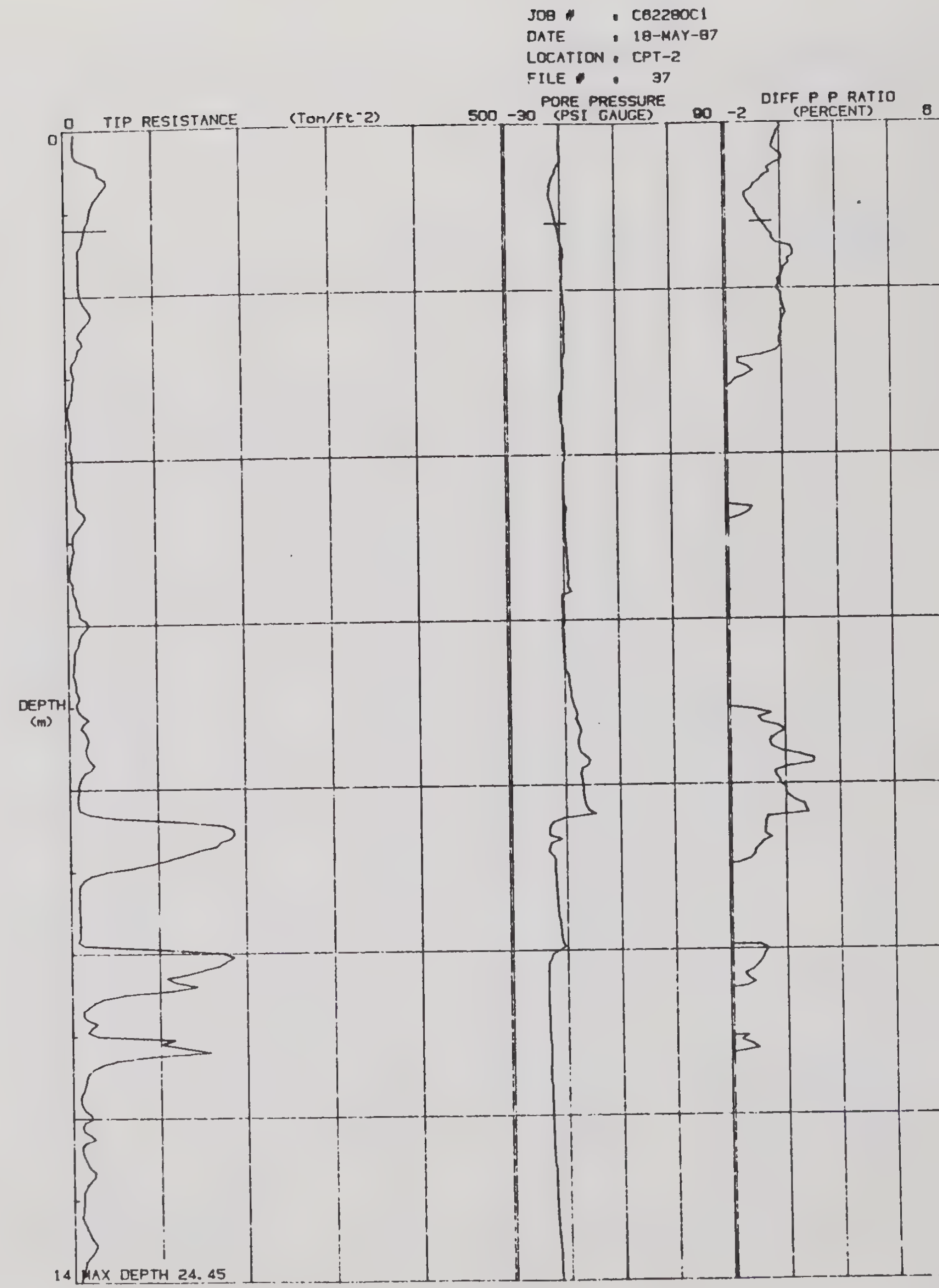


CPT Data: Tip Resistance, Pore Pressure, and Differential Pore Pressure Ratio



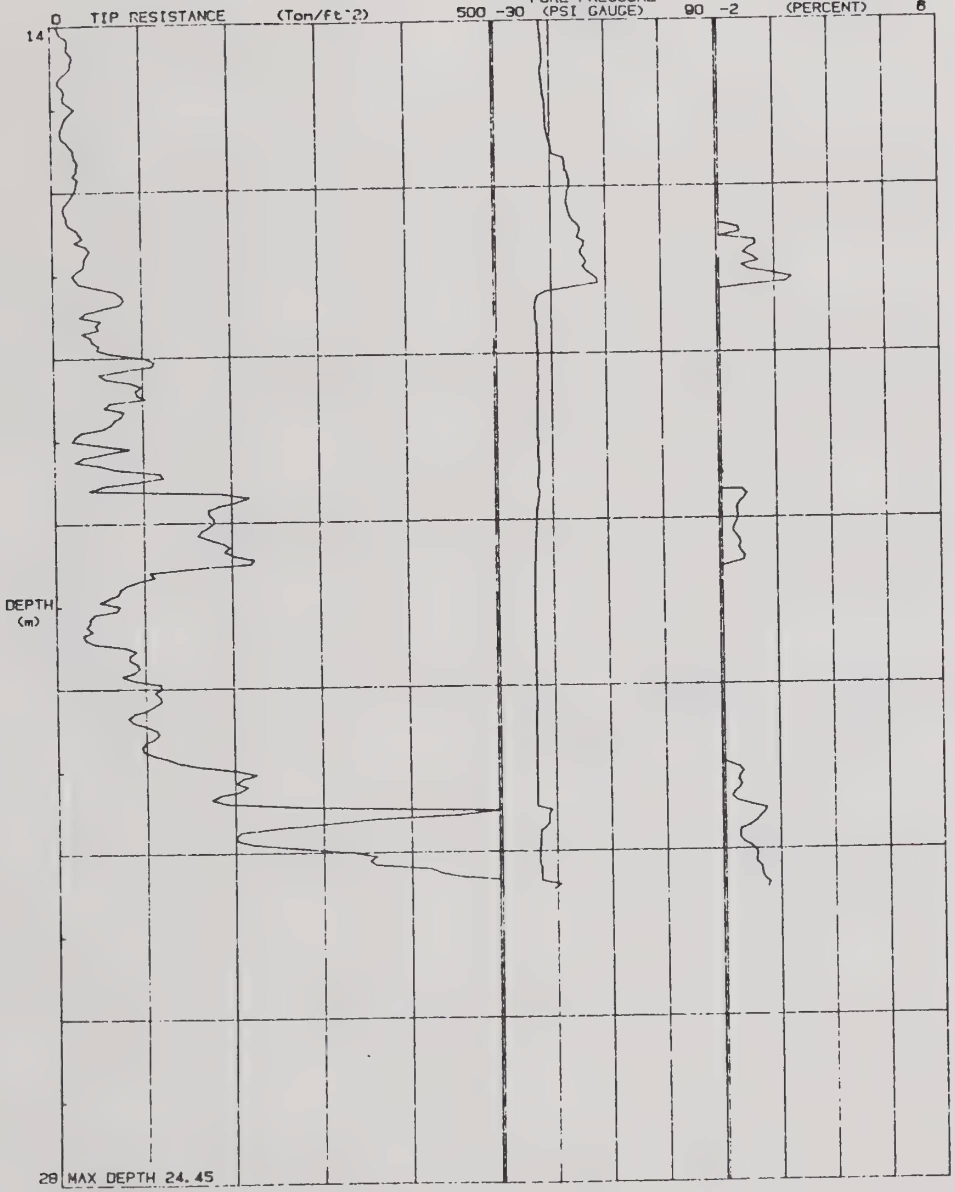

JOB # : C82280C1
DATE : 18-MAY-87
LOCATION : CPT-1
FILE # : 38
0 TIP RESISTANCE (Ton/Ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 19.45

A-13

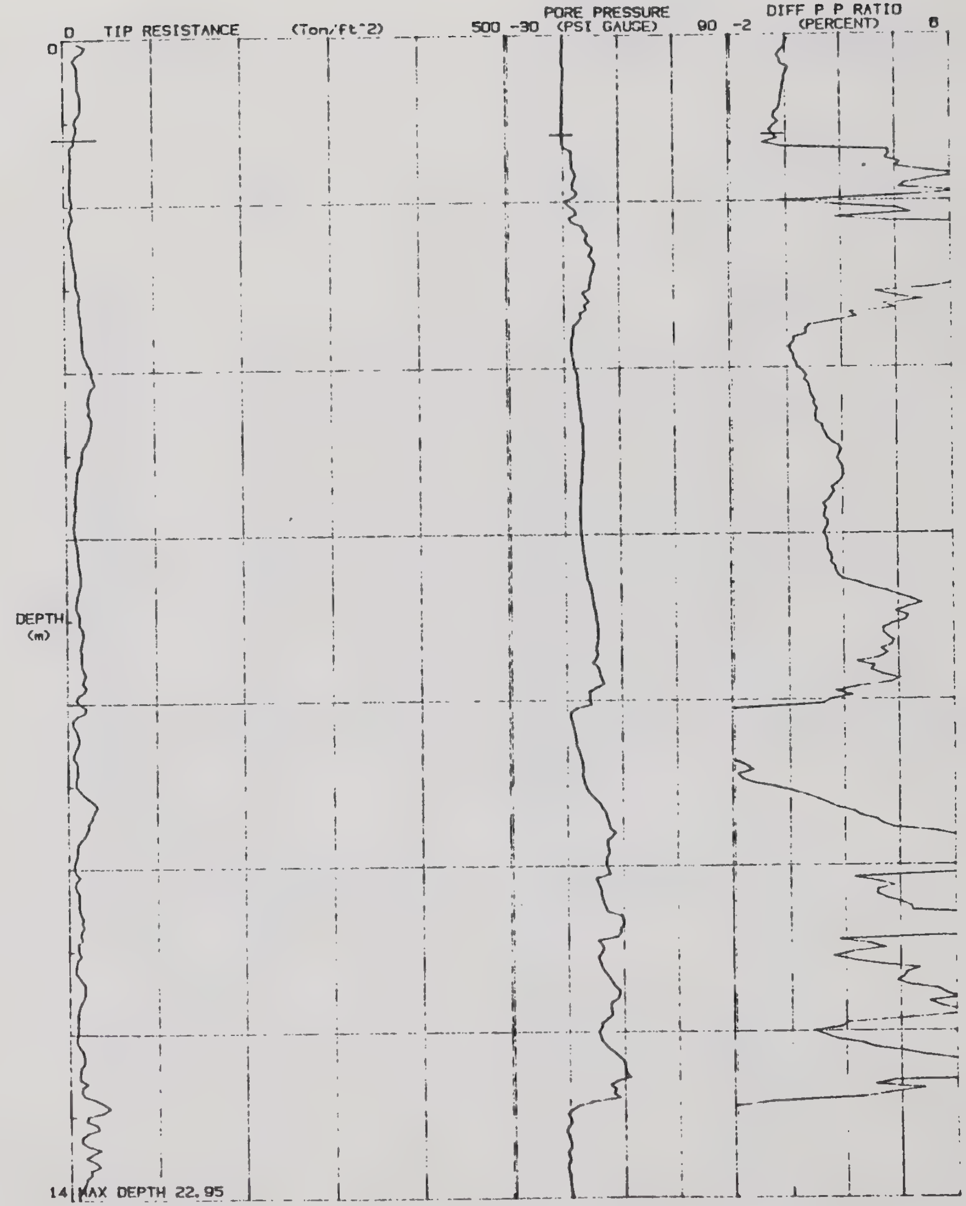

JOB # : C82280C1
DATE : 18-MAY-87
LOCATION : CPT-2
FILE # : 37
0 TIP RESISTANCE (Ton/Ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 24.45

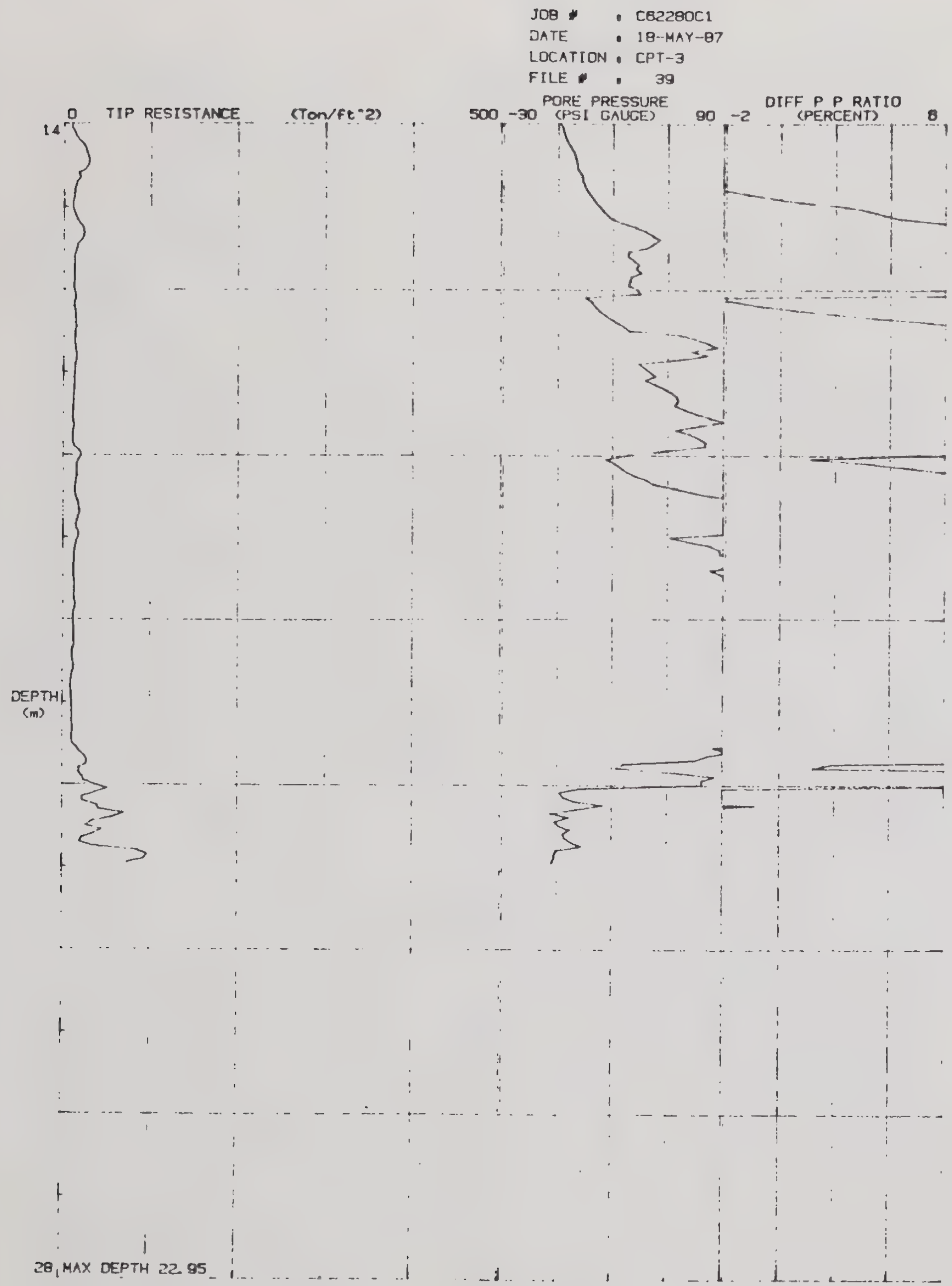
A-14

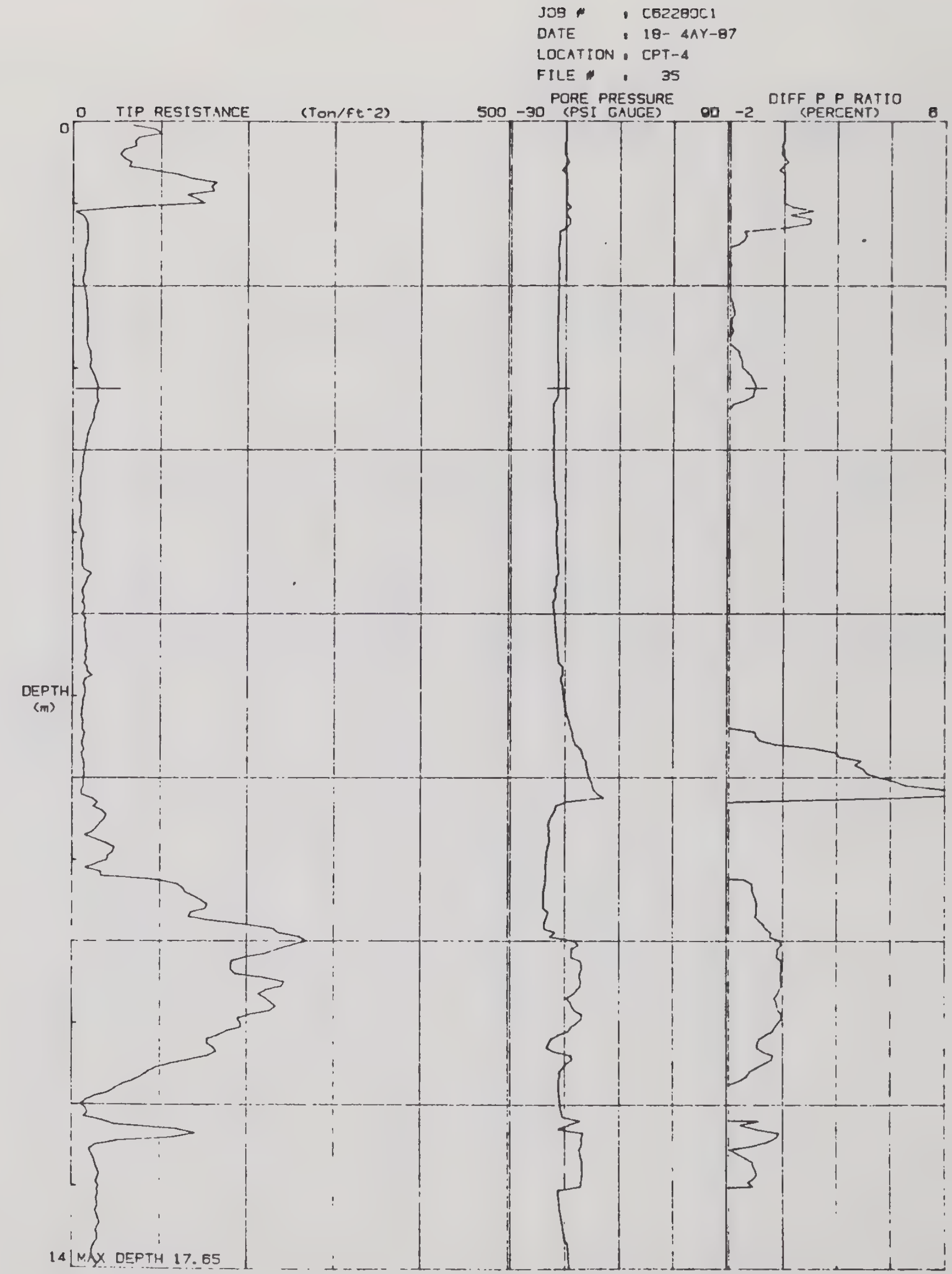
JOB # : C6228OC1
DATE : 18-MAY-87
LOCATION : CPT-2
FILE # : 37

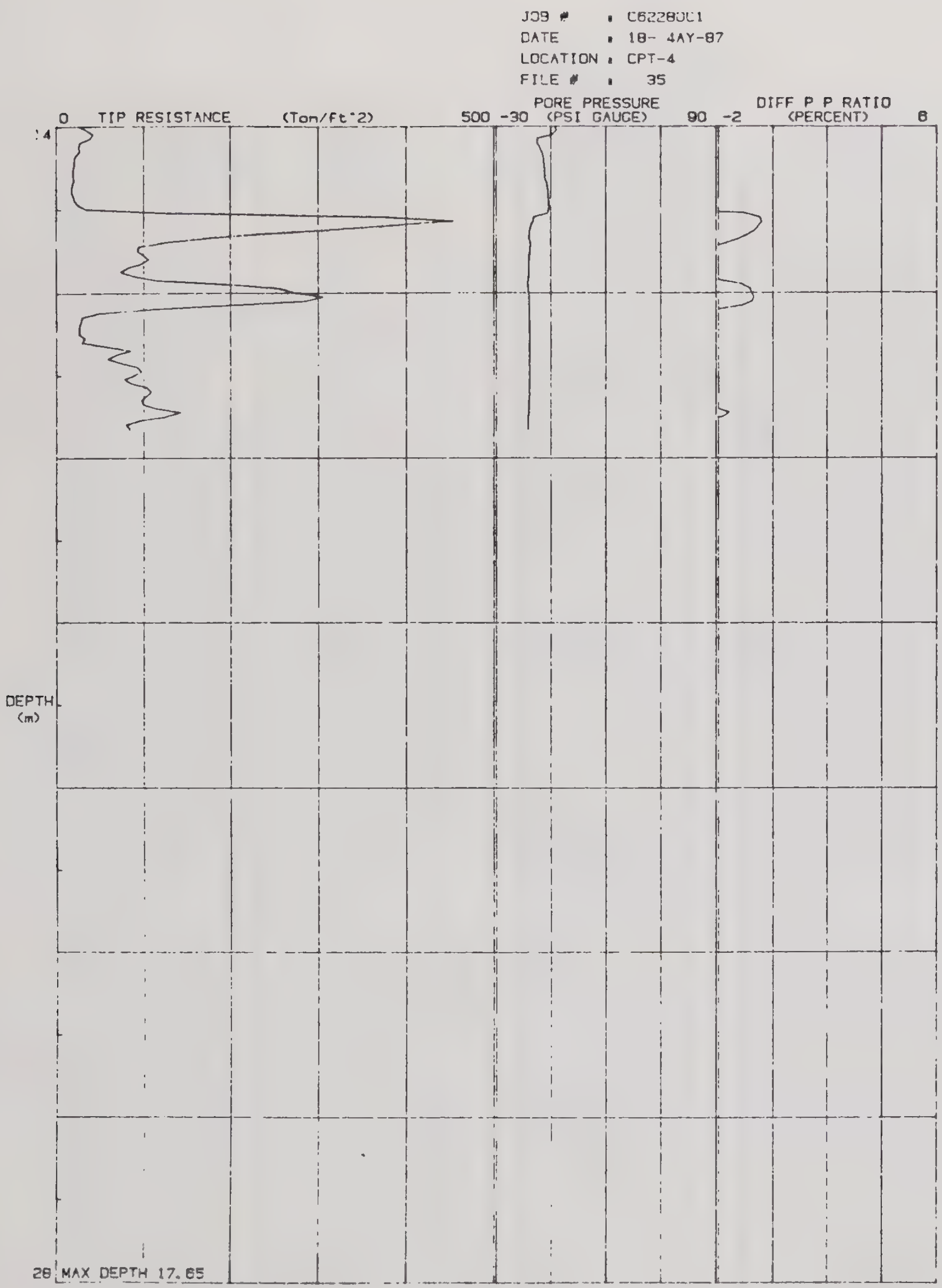


JOB # : C6228OC1
DATE : 18-MAY-87
LOCATION : CPT-3
FILE # : 39

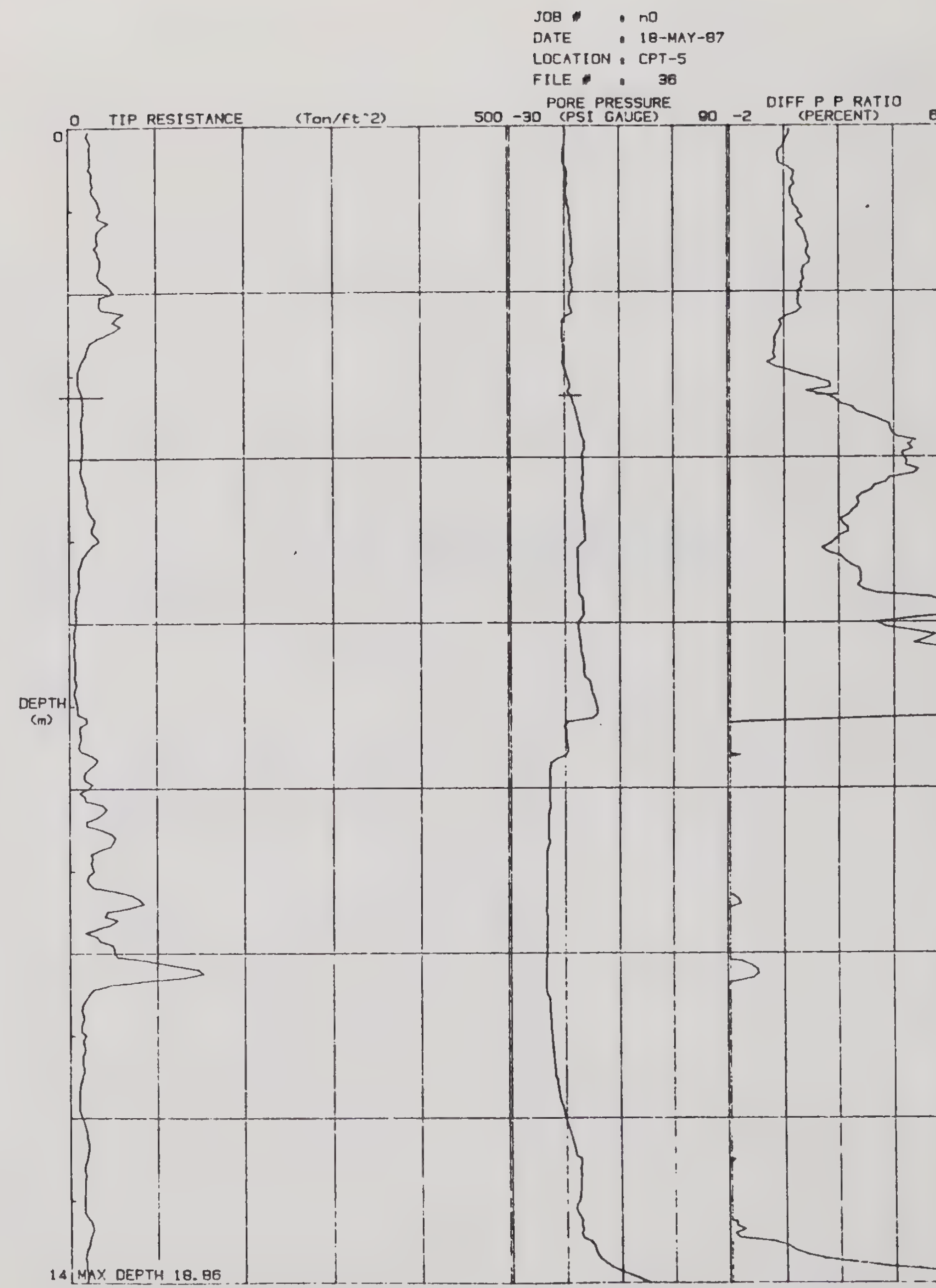



JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-3
FILE # : 39
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
14
DEPTH (m)
28 MAX DEPTH 22.95

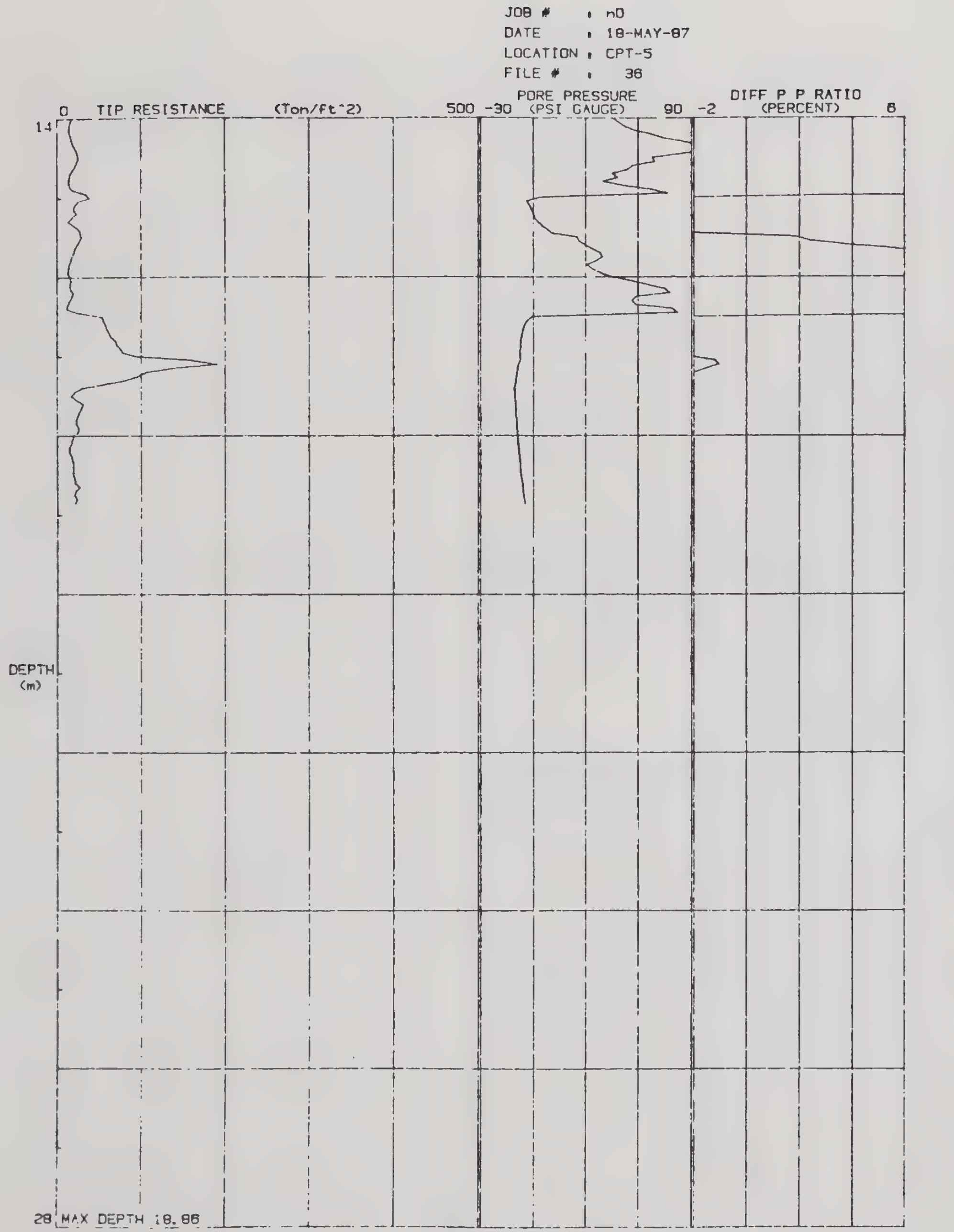

JOB # : C62280C1
DATE : 18- 4AY-87
LOCATION : CPT-4
FILE # : 35
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 8
0
DEPTH (m)
14 MAX DEPTH 17.65



JOB # : C62280C1
DATE : 18- 4AY-87
LOCATION : CPT-4
FILE # : 35
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 6
14
DEPTH (m)
28
MAX DEPTH 17.65



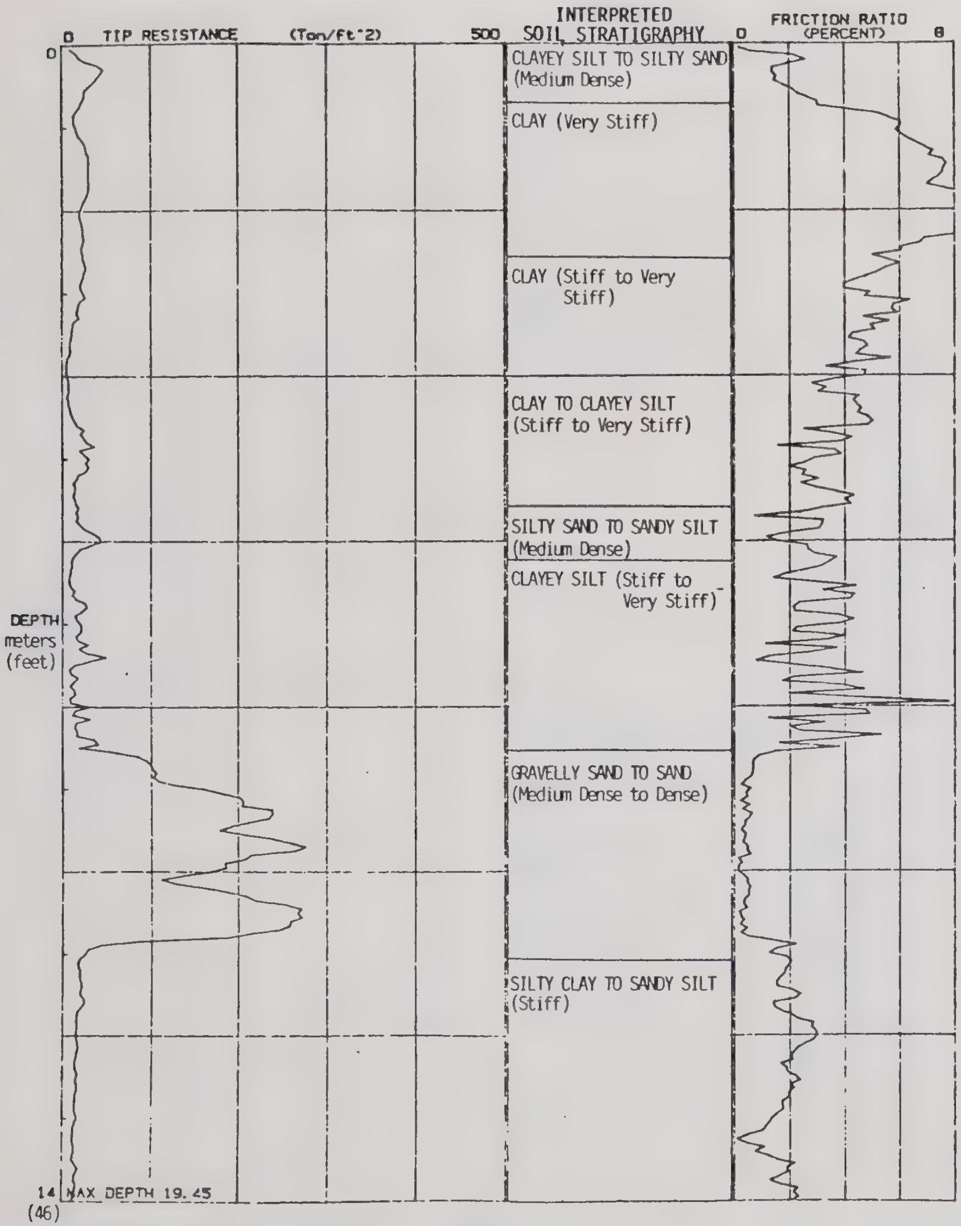
JOB # : nO
DATE : 18-MAY-87
LOCATION : CPT-5
FILE # : 36
0 TIP RESISTANCE (Ton/ft^2) 500
-30 PORE PRESSURE (PSI GAUGE) 90
-2 DIFF P P RATIO (PERCENT) 6
0
DEPTH (m)
14
MAX DEPTH 18.86



CPT Data: Interpreted Soil Stratigraphy

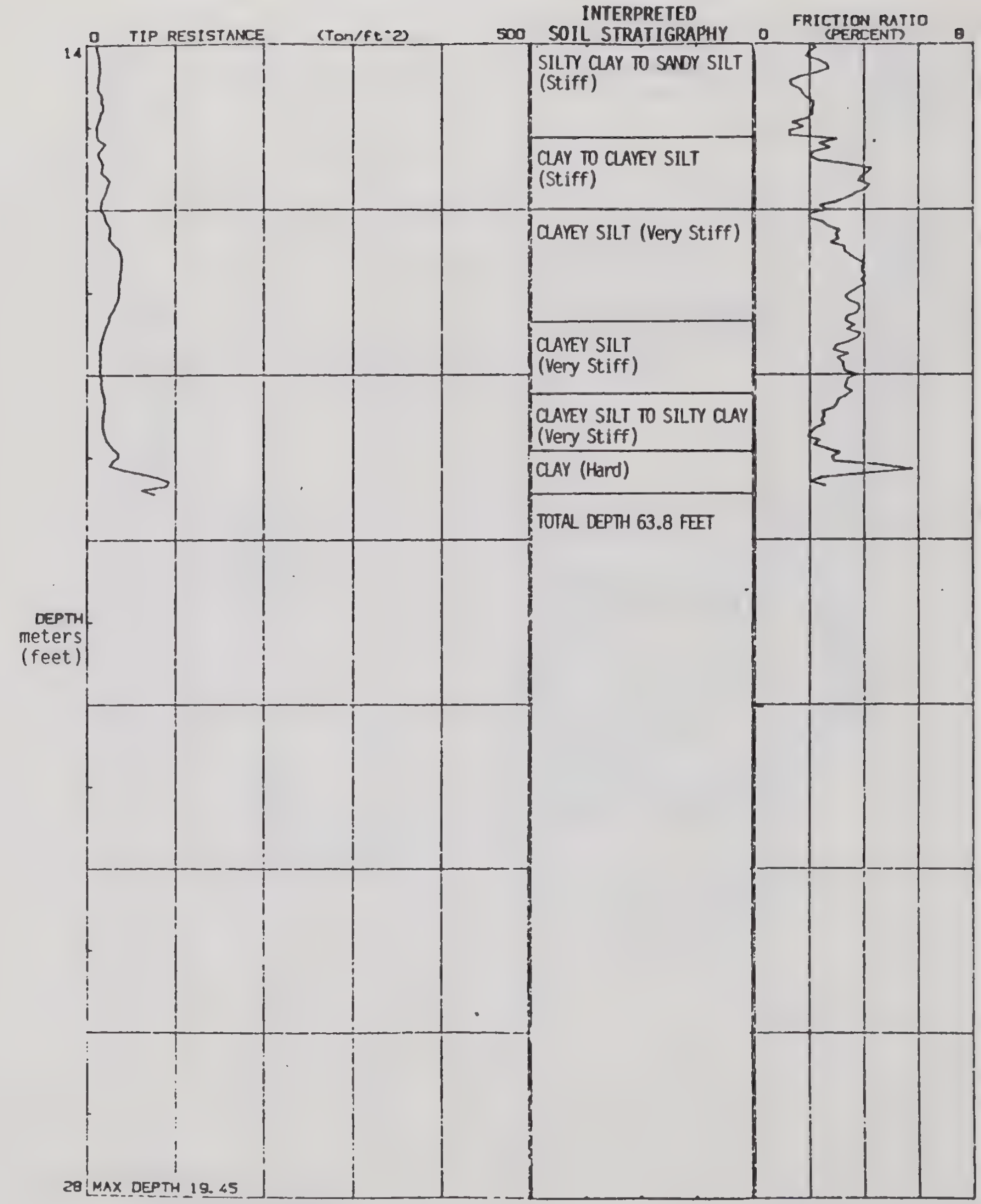
File No. C6-2280-C1

JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-1



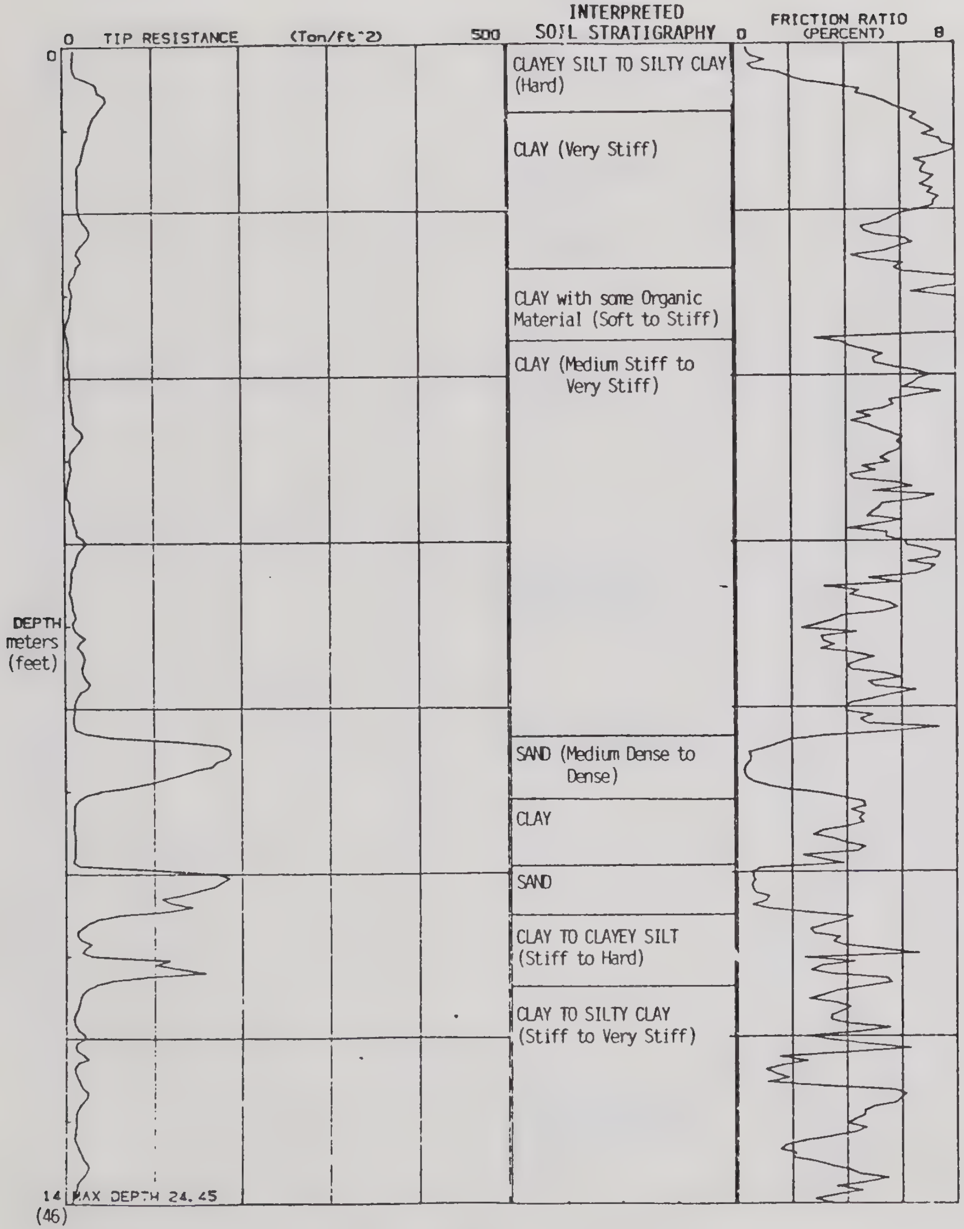
File No. C6-2280-C1

JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-1



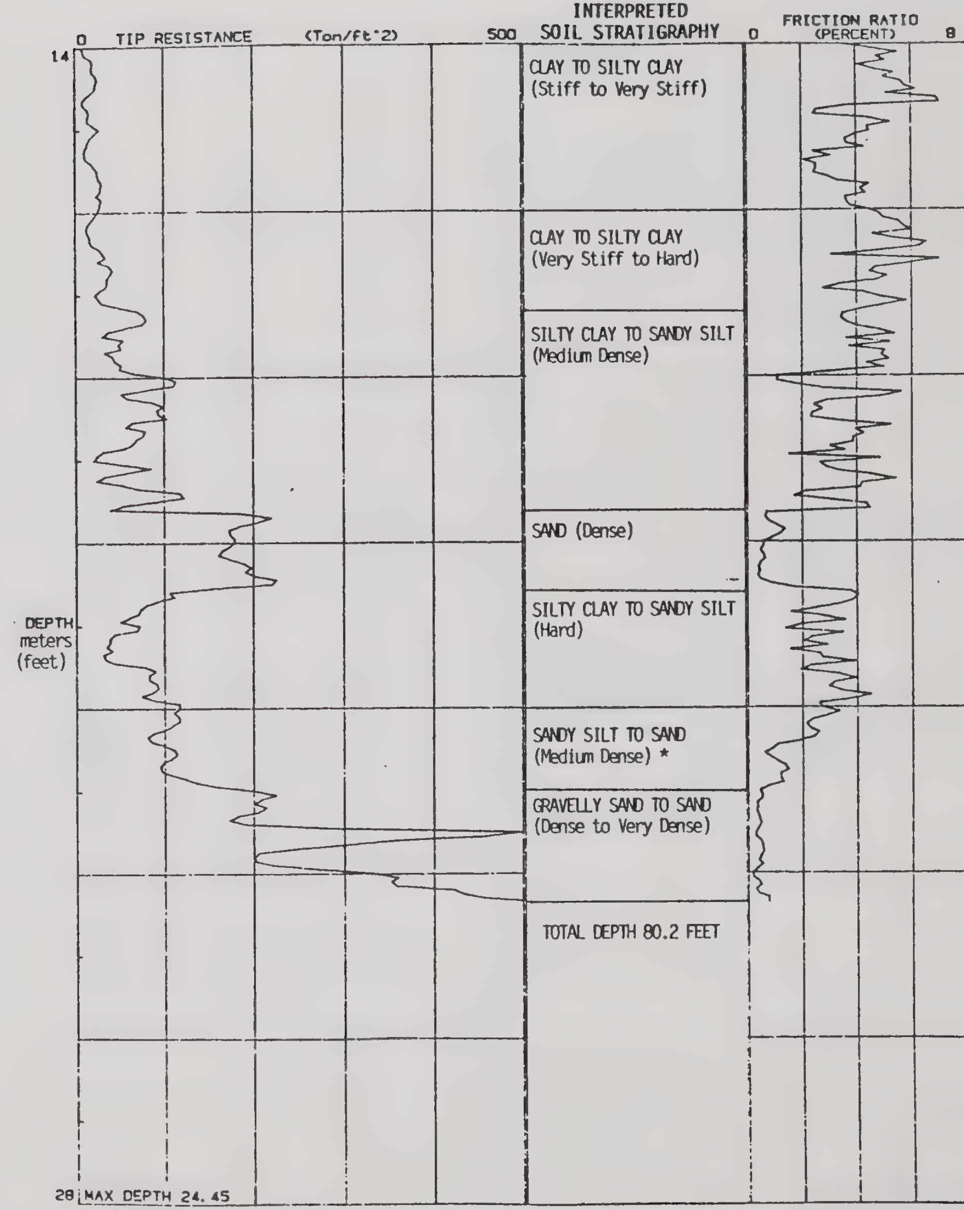
File No. C6-2280-C1

JOB # : C82280C1
DATE : 18-MAY-87
LOCATION : CPT-2



File No. C6-2280-C1

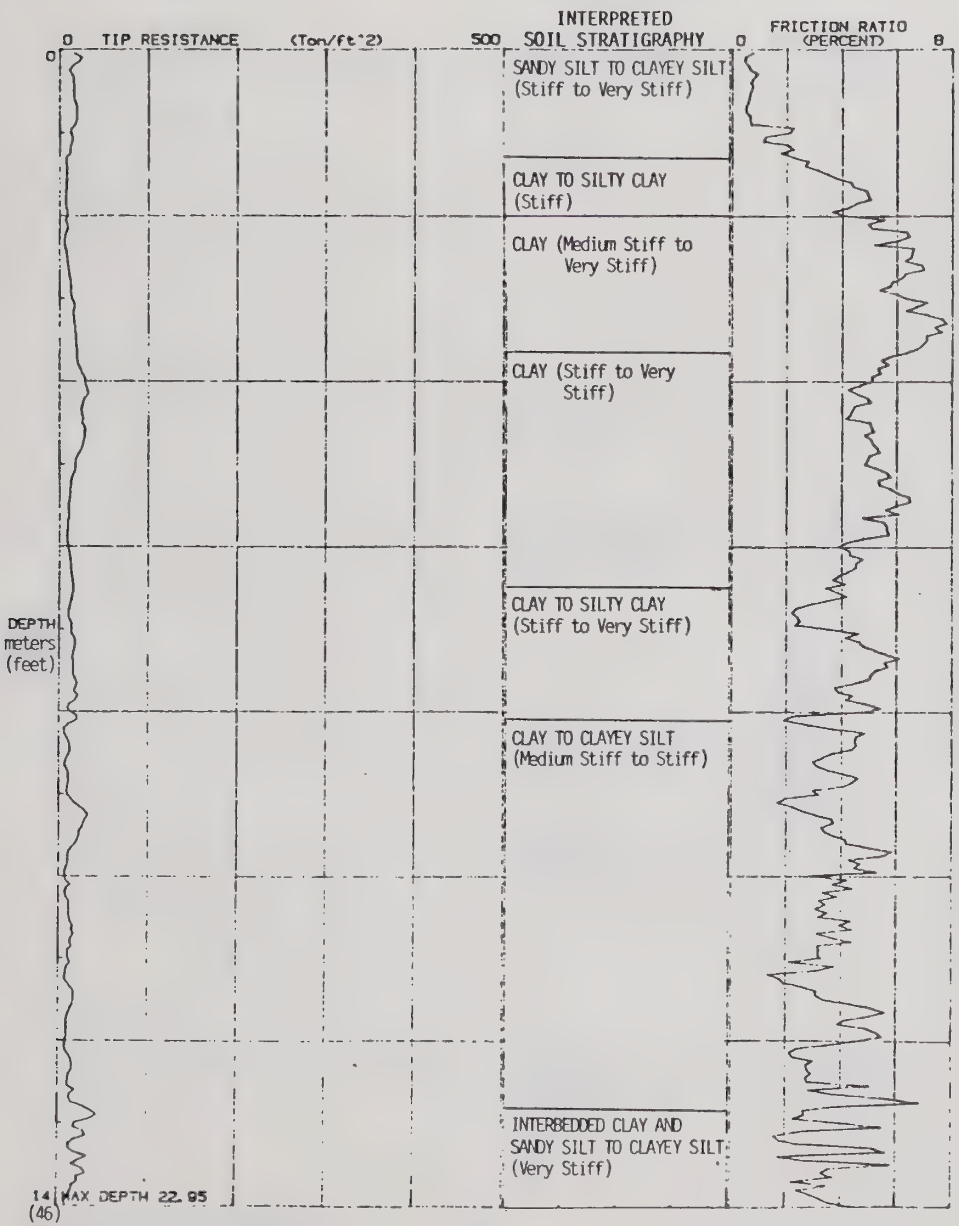
JOB # : C82280C1
DATE : 18-MAY-87
LOCATION : CPT-2



* Potentially Liquefiable

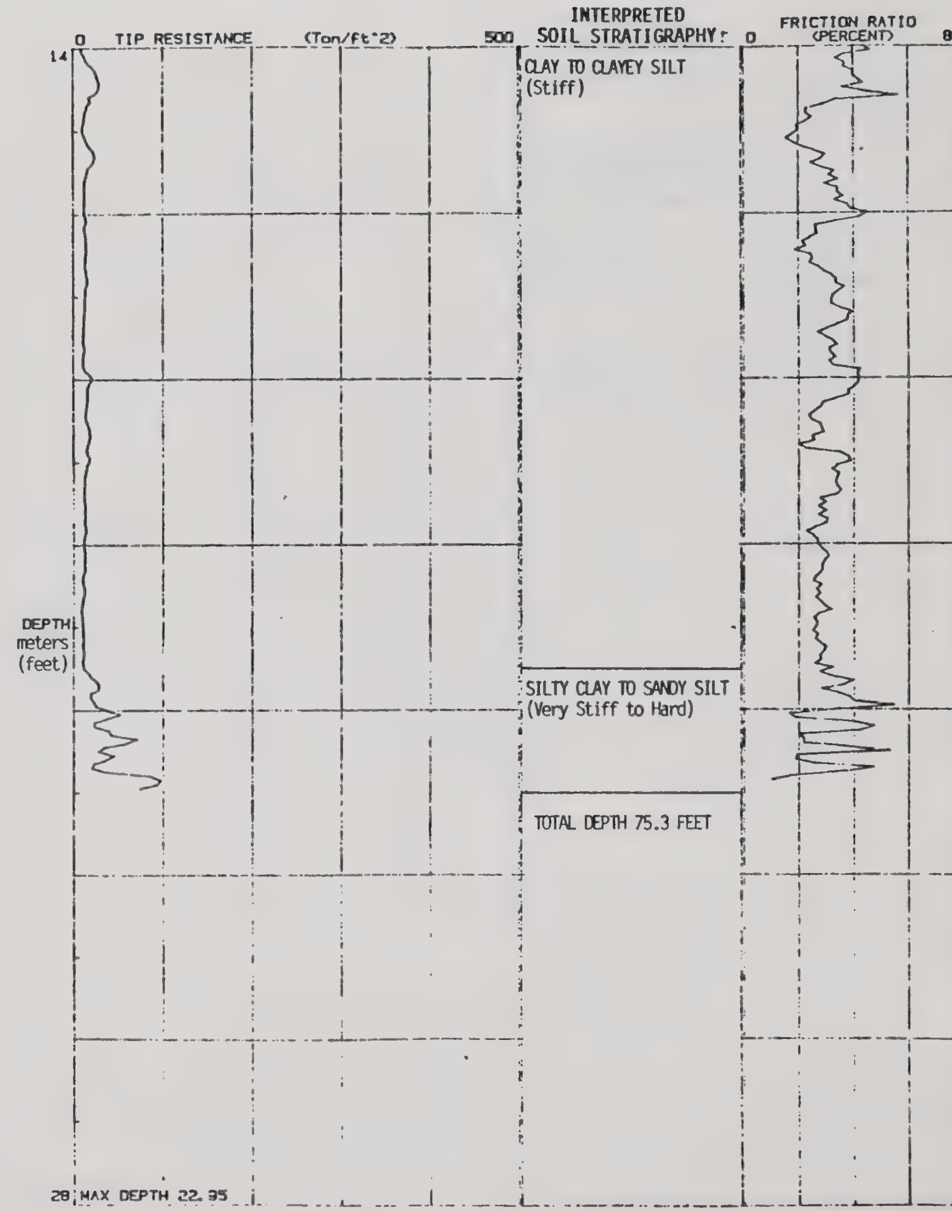
File No. C6-2280-C1

JOB # : C62280C1
DATE : 18-MAY-87
LOCATION : CPT-3



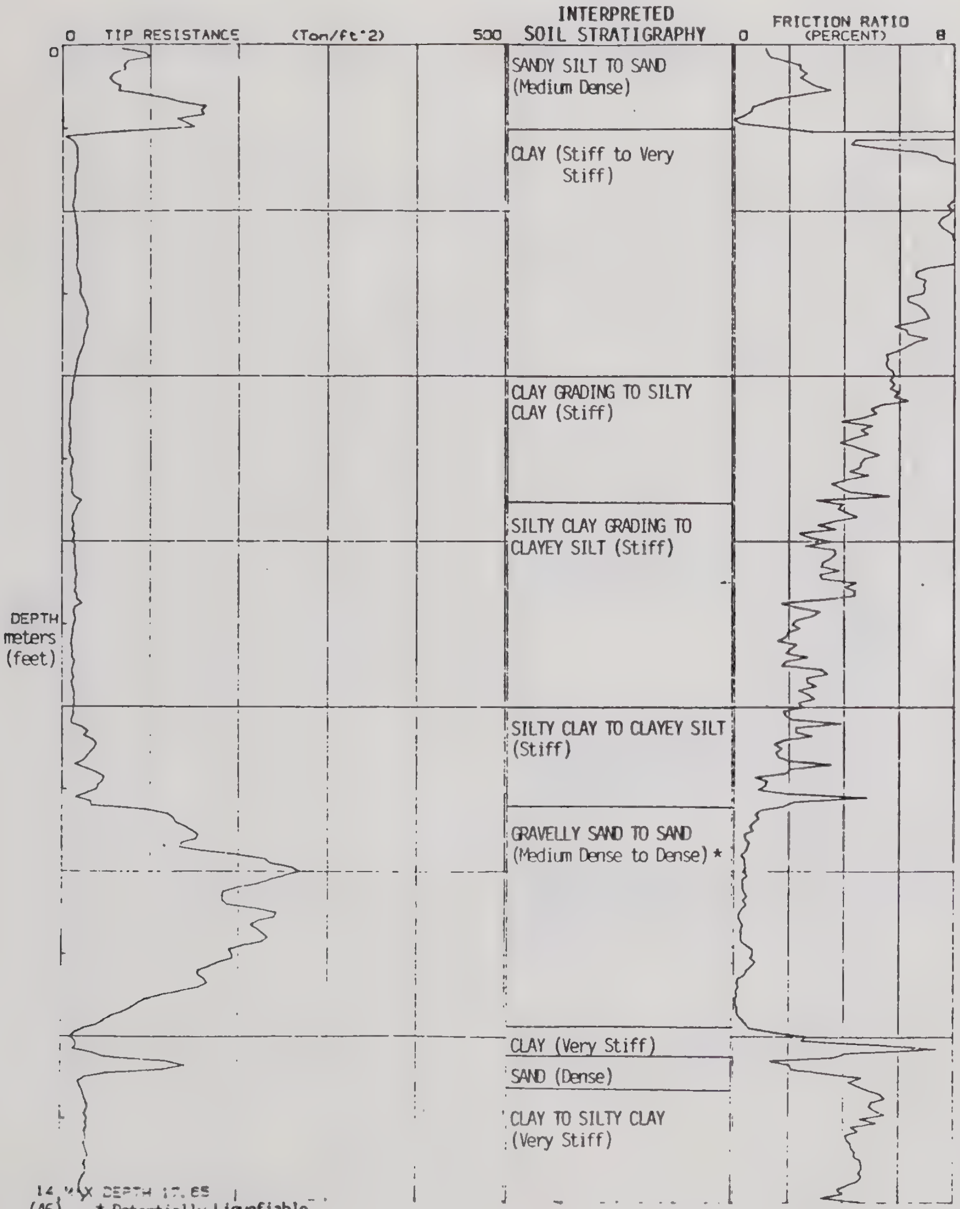
File No. C6-2280-C1

DATE : 18-MAY-87
LOCATION : CPT-3



File No. C6-2280-C1

JOB # : C62280C1
DATE : 18- MAY-87
LOCATION : CPT-4

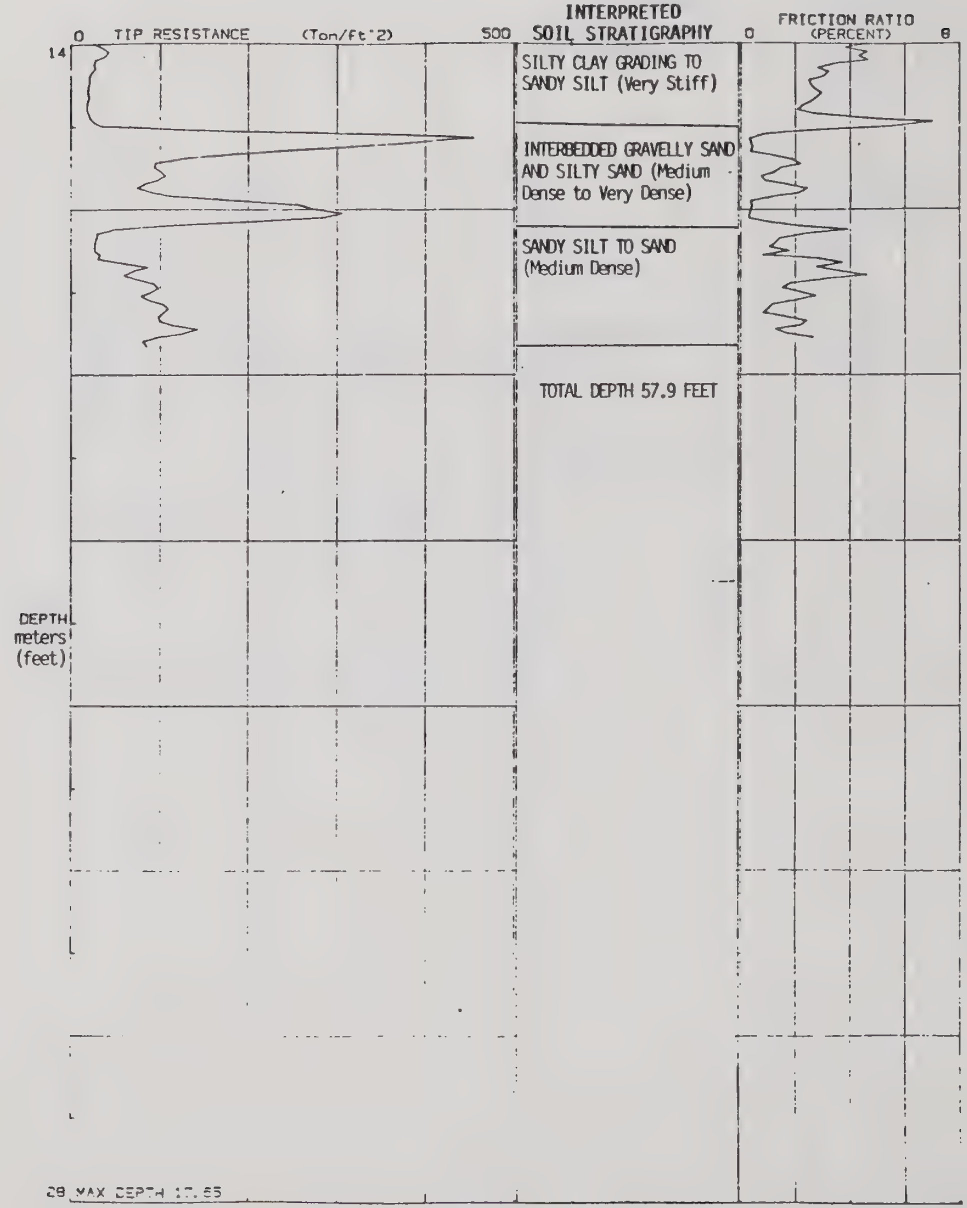


* Potentially Liquefiable

A-28

File No. C6-2280-C1

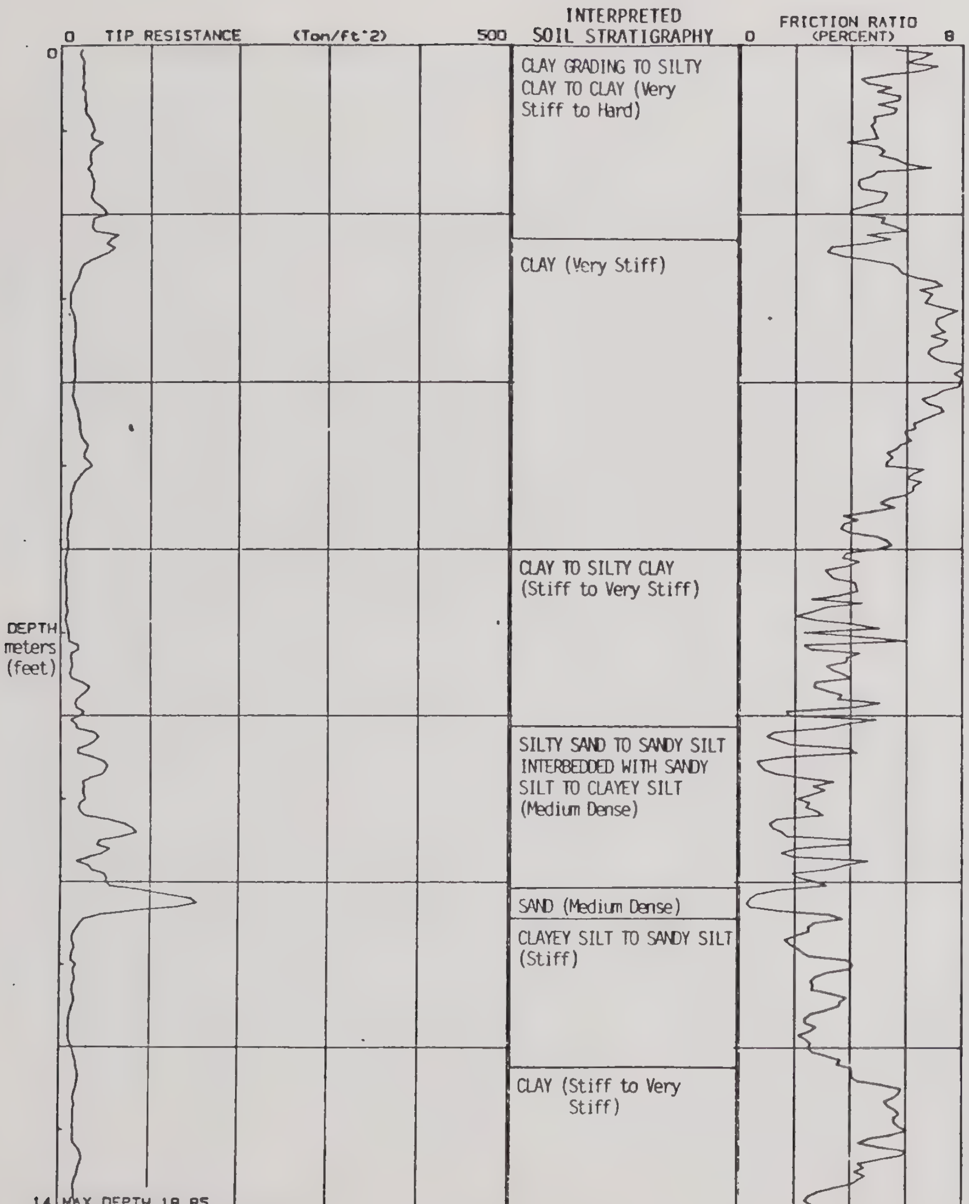
JOB # : C62280C1
DATE : 18- MAY-87
LOCATION : CPT-4



A-29

File No. C6-2280-C1

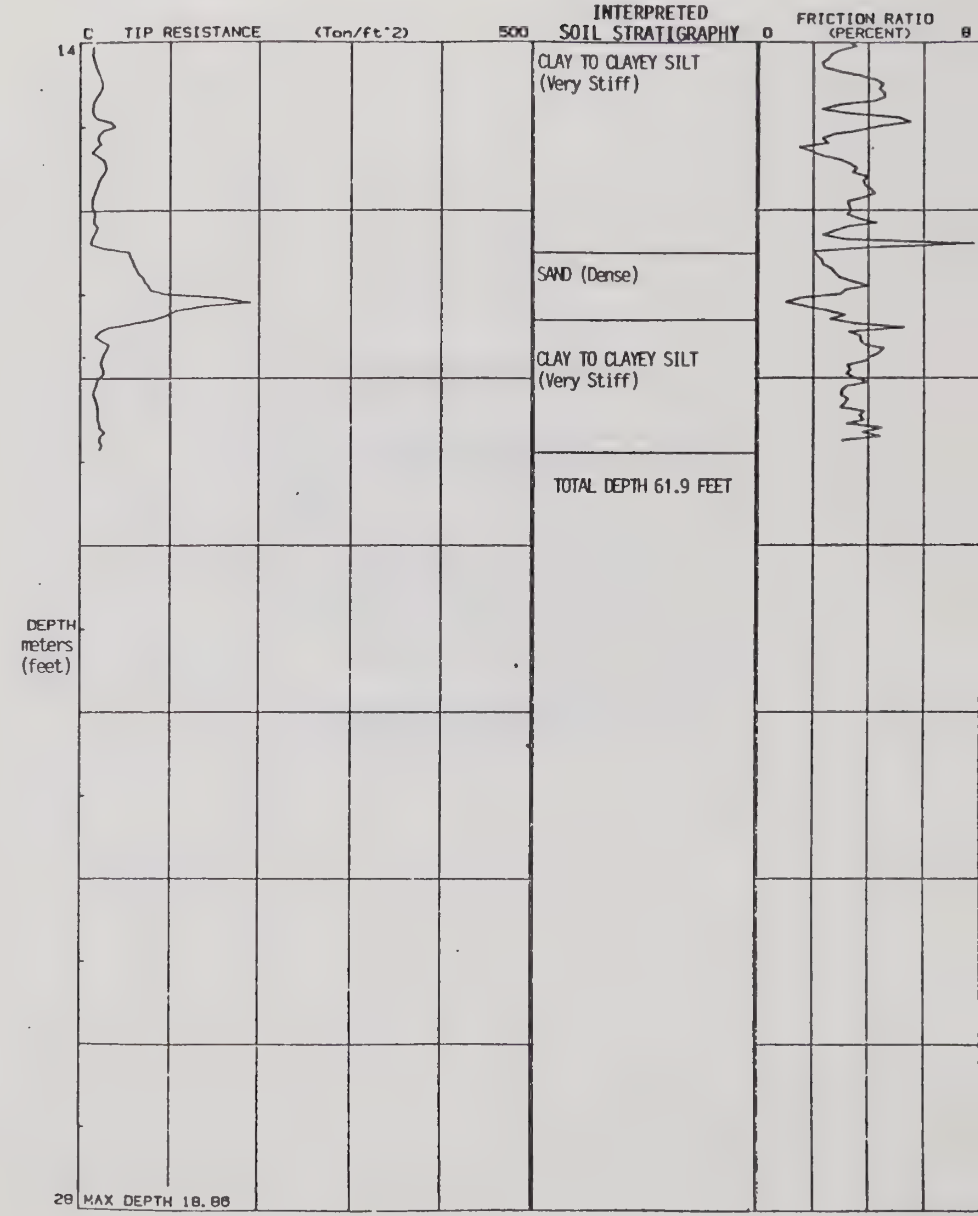
JOB # : n0
DATE : 18-MAY-87
LOCATION : CPT-5



* Potentially Liquefiable

File No. C6-2280-C1

DATE : 18-MAY-87
LOCATION : CPT-5



Logs of Borings

KEY TO LOGS OF BORINGS

	3" O.D. Modified California Sampler
	Bulk Sample
O	Pocket Penetrometer Test (in tsf)
∇	Groundwater Encountered During Drilling
(14)	Estimated Standard Penetration Test Blow Counts (N Value)

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				Boring C1		
				Fill: Yellow brown silty CLAY with sand, damp, stiff (CL)		
5	C1-1		49 (31)	Yellow brown sandy CLAY with laminated dark silty clay seams, moist, stiff (CL) 4.5+	104	17
10	C1-2		22 (17)	Dark grey silty CLAY with minor fine sand, moist, very stiff (CH) 2.75	101	23
15	C1-3		29 (21)	Olive grey silty CLAY, moist, very stiff (CH) 2.75		
	C1-4		17 (13)	Orange fine sandy CLAY, very moist to wet, stiff (CL) 1.75	109	20
20				Tan fine sandy SILT with clay, saturated, medium stiff (ML)		
	C1-5		11 (9)	Dark grey brown sandy SILT with clay, saturated, stiff (ML) 0.9	95	26
25				Log continued on next page...		

File No. C6-2280-C1

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				Boring C1 - continued		
	C1-6		23 (13)	Tan silty fine SAND with clay, to fine sandy SILT, saturated, medium dense (SM-SC)		
30	C1-7		41 (26)	Tan silty SAND with trace clay, saturated, dense (SM)	102	22
35	C1-8		36 (21)	Dark brown poorly graded SAND, medium grained, subangular, saturated, medium dense to dense (SW)	-	21
				Orange silty CLAY, damp, hard (CL) 4.0		
40	C1-9		20 (15)	Orange silty CLAY with fine sand, very moist, stiff (CL) 1.0		
				Boring terminated at 40 feet. Drilled May 26, 1987.		

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
				Boring C2		
0				Fill: Yellow brown sandy SILT, damp, stiff (ML)		
5	C2-1 A		17 (13)	Grey-brown silty CLAY, moist, stiff (CH) 1.9	94	18
	C2-2		20 (8)	Light olive-brown silty CLAY, very moist, stiff (CL) 1.0	91	31
10				Light olive-brown fine sandy CLAY, very moist, stiff (CL)		
15	C2-3		18 (14)	Grey silty CLAY, moist, stiff (CH) 1.9	95	29
20	C2-4		10 (8)	0.9 -with minor organics	89	34
25	C2-5		14 (11)	Olive grey alternating CLAY, SAND, sandy SILT, sandy CLAY, saturated, stiff (SC-ML-CL)	-	25
				Log continued on next page...		

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				Boring C2 - continued		
30	C2-6			Very dark grey gravelly SAND with minor silt, well-graded, subrounded, saturated, dense (SW)	-	15
35	C2-7			Very dark grey black SAND with minor silt, poorly graded, medium grained, subrounded (SP)		
40	C2-8		27	Orange silty CLAY with sand, damp, hard (CL) 4.5+	-	33
				Boring terminated at 40 feet. Drilled May 26, 1987.		

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
0				Boring C3		
				Fill: Orange-brown fine sandy CLAY to sandy SILT, damp, very stiff (CL)		
5	C3-1		52 (32)	Grey brown silty CLAY, moist, hard (CL-CH) 4.25	103	22
10	C3-2		72 (44)	Olive brown silty CLAY, moist, hard (CH) 4.5+		
	C3-3		17 (10)	Tan sandy CLAY, moist, stiff (CL)	105	22
15				Tan clayey fine to medium SAND, wet, medium dense (SC) 1.5		
20	N.R.			Tan silty fine SAND with some clay, saturated, medium dense		
	C3-4				115	22
25	C3-5				96	27

Log continued on next page...

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY pcf	IN-PLACE MOISTURE CONTENT % dry wt
25				Boring C3 - continued		
				Grey tan silty fine SAND with gravel, saturated, medium dense (SW-GP)		
30	C3-6				-	25
				Tan fine to coarse SAND, saturated, dense (SW)		
35	C3-7				-	20
				Alternating layers of medium and coarse SAND (SP)		
40	C3-8				-	16
45				Boring terminated at 43½ feet. Drilled May 26, 1987.		

APPENDIX B

Summary of Laboratory Test Results

Direct Shear Test Results

Grain Size Analysis Results

Consolidation Test Results

Table 1

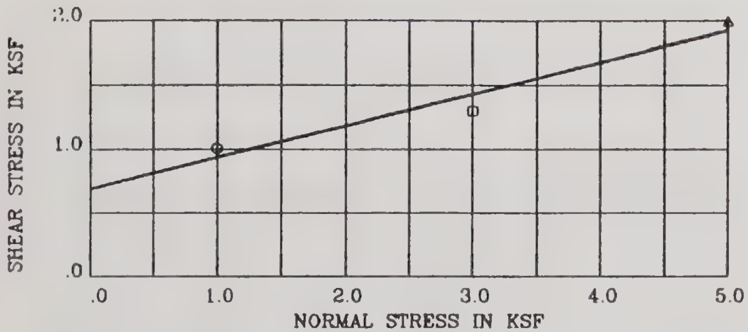
Summary of Moisture, Density, Swell and Direct Shear Testing

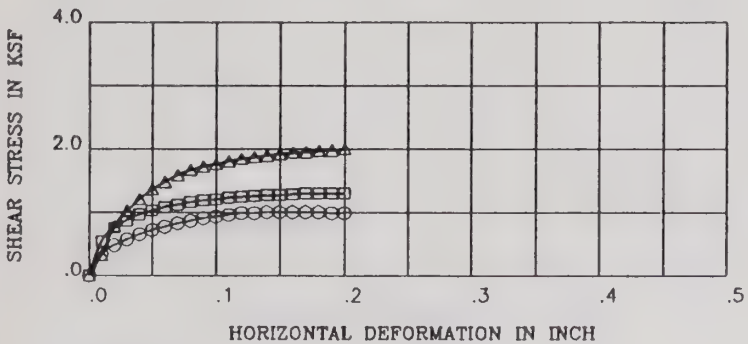
		In-Place Conditions		Swell Tests			Direct Shear Testing	
Sample Number	Depth (Ft.)	Dry Density pcf	Moisture Content % Dry Wt	Swell Index (A)	% Swell	Moisture Increase % (B)	Angle Of Internal Friction Degrees	Unit Cohesion psf
C1-1	4	104	17					
C1-2	9	101	23					
C1-3	13	103	23					2390 (u)
C1-4	12	109	20	0.1	0.1	1.0	14	690
C1-5	22	95	26					
C1-6	28			See Grain Size Analysis				
C1-7	31	102	22					
C1-8	35	-	21					
C1-9	39	106	21					1440 (u)
C2-1	4	94	18					
C2-2	9	91	31					
C2-3	13	95	29	0.4	0.5	1.2	2	650
C2-3								1165 (u)
C2-4	19	89	34	0.6	0.8	1.4	2	530
C2-4				See Consolidation Test				
C2-5	24	-	25					
C2-6	29	-	15					
C2-7	34			See Grain Size Analysis				
C2-8	39	-	33					
C3-1	4	103	22					
C3-2	9	110	19					4280 (u)
C3-3	14	105	22					
C3-4	20			See Grain Size Analysis				
C3-5	24	96	27					
C3-6	29	-	25					
C3-7	34	-	20					
C3-8	39	-	16					

NOTES: (A) - Swell Index equals percent swell divided by percent moisture increase.

(B) - Moisture Increase following at least 24 hours of soaking prior to testing.

(u) - Strength obtained from Unconfined Compression Test.





BORING/SAMPLE : 1-4-1 DEPTH (ft) : 16.5
DESCRIPTION : Moist medium stiff
STRENGTH INTERCEPT (C) : .693 KSF (PEAK STRENGTH)
FRICTION ANGLE (PHI) : 13.9 DEG (PEAK STRENGTH)

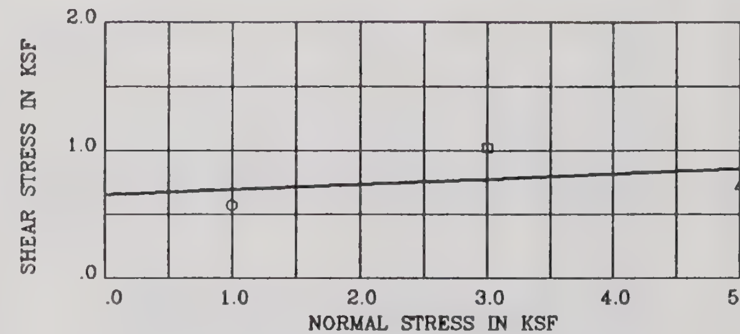
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	25.2	108.8	3.588	1.00	1.01	.99
□	20.7	109.7	.536	3.00	1.30	1.30
△	20.4	109.8	.534	5.00	2 00	2.00

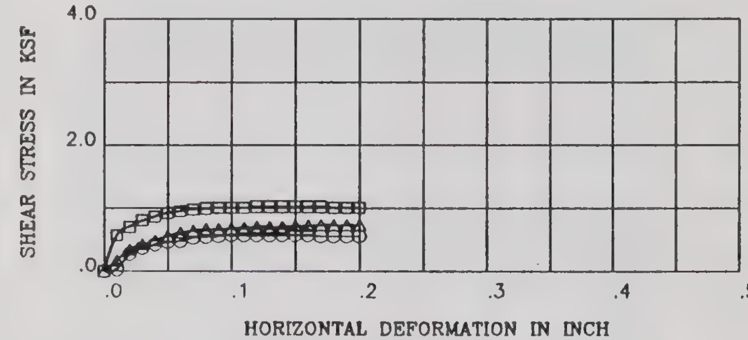
Remark : Slightly mtld olive brn sandy lean clay w/silt(CL)

C6-2280-C1

Earth Systems

DIRECT SHEAR TEST





BORING/SAMPLE : 2-3-2/2-4 DEPTH (ft) : 13.5'/19'
DESCRIPTION : fat clay (CH)
STRENGTH INTERCEPT (C) : .653 KSF (PEAK STRENGTH)
FRICTION ANGLE (PHI) : 2.3 DEG (PEAK STRENGTH)

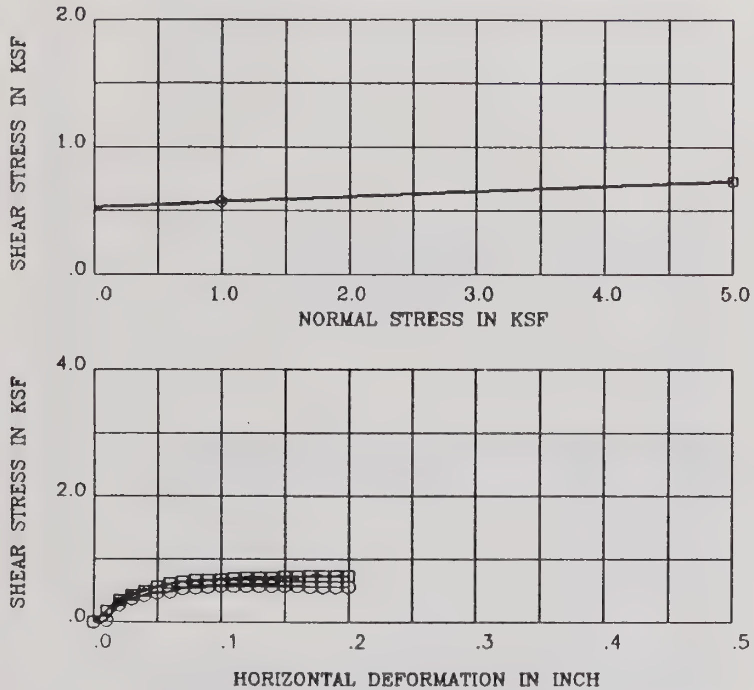
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	33.2	90.3	.865	1.00	.57	.56
□	28.9	94.7	.779	3.00	1.02	1.00
△	35.1	88.4	.905	5.00	.73	.73

Remark : Mottled v.gry w/ol brn, v.moist,med stiff to stiff

C6-2280-C1

Earth Systems

DIRECT SHEAR TEST

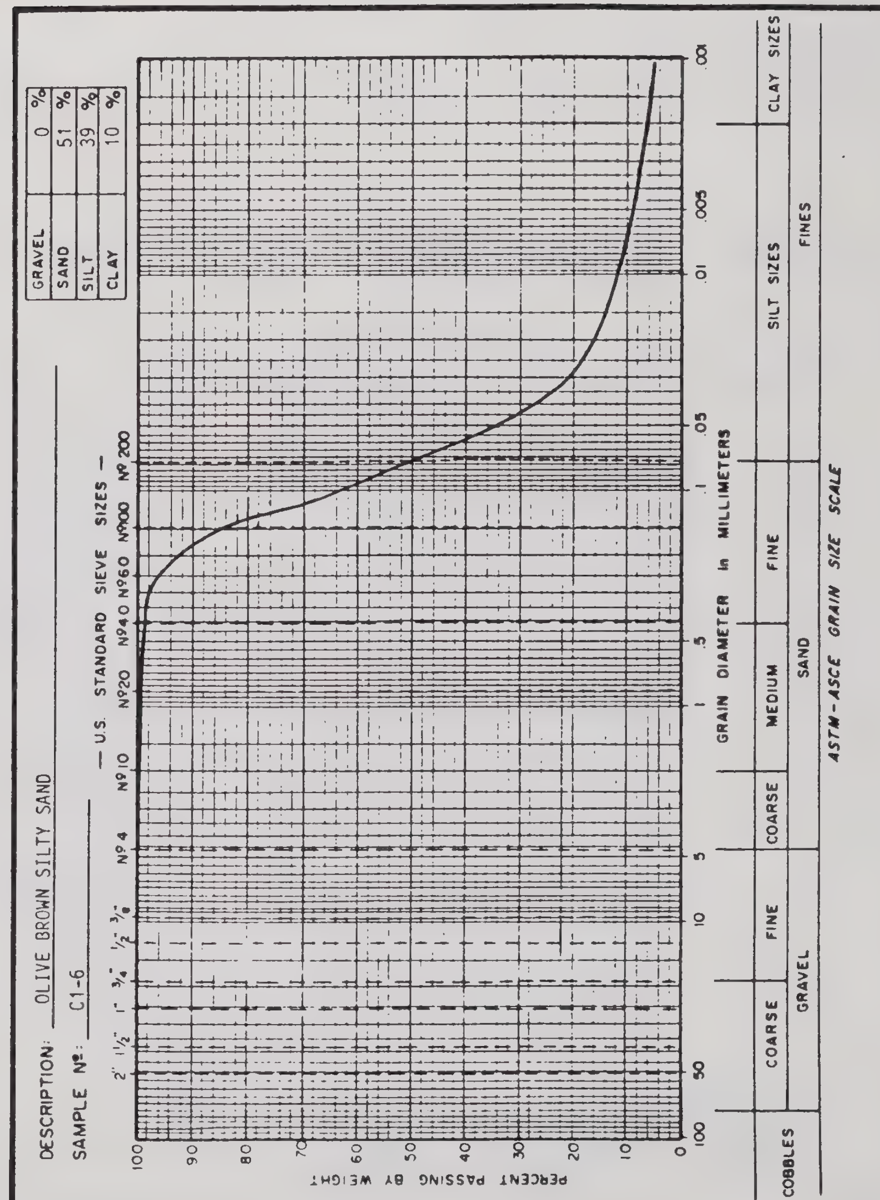


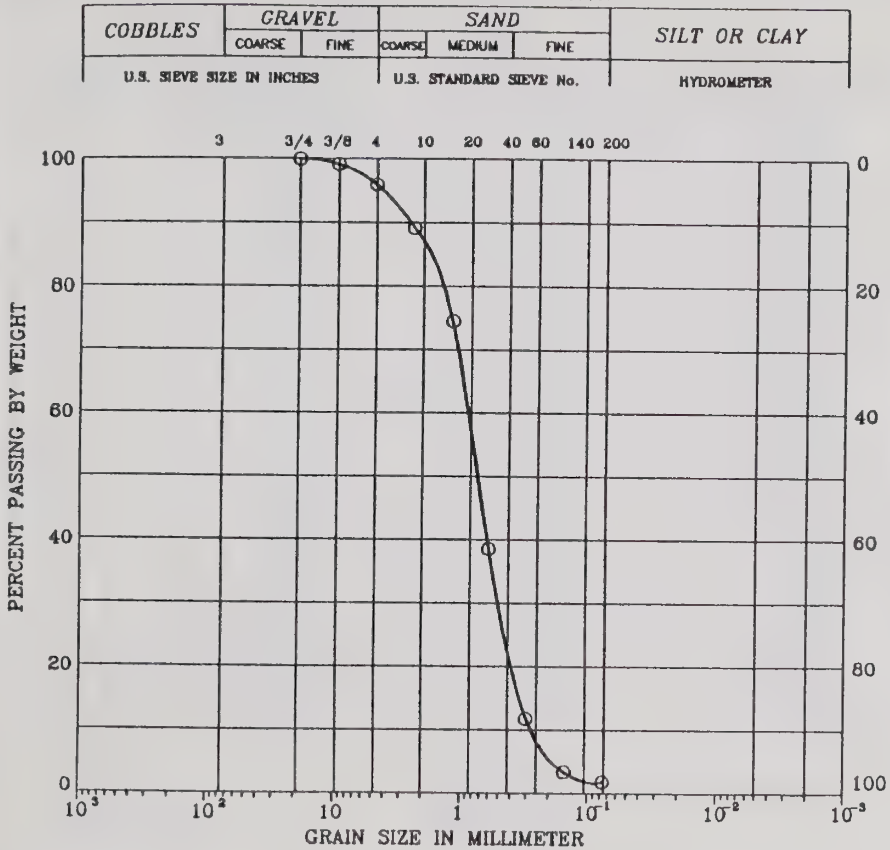
BORING/SAMPLE : 2-4 DEPTH (ft) : 19
DESCRIPTION :
STRENGTH INTERCEPT (C) : .531 KSF (PEAK STRENGTH)
FRICTION ANGLE (PHI) : 2.3 DEG (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	33.2	90.3	.865	1.00	.57	.56
□	35.1	88.4	.905	5.00	.73	.73

Remark : Dark

C6-2280-C1	
Earth Systems	DIRECT SHEAR TEST

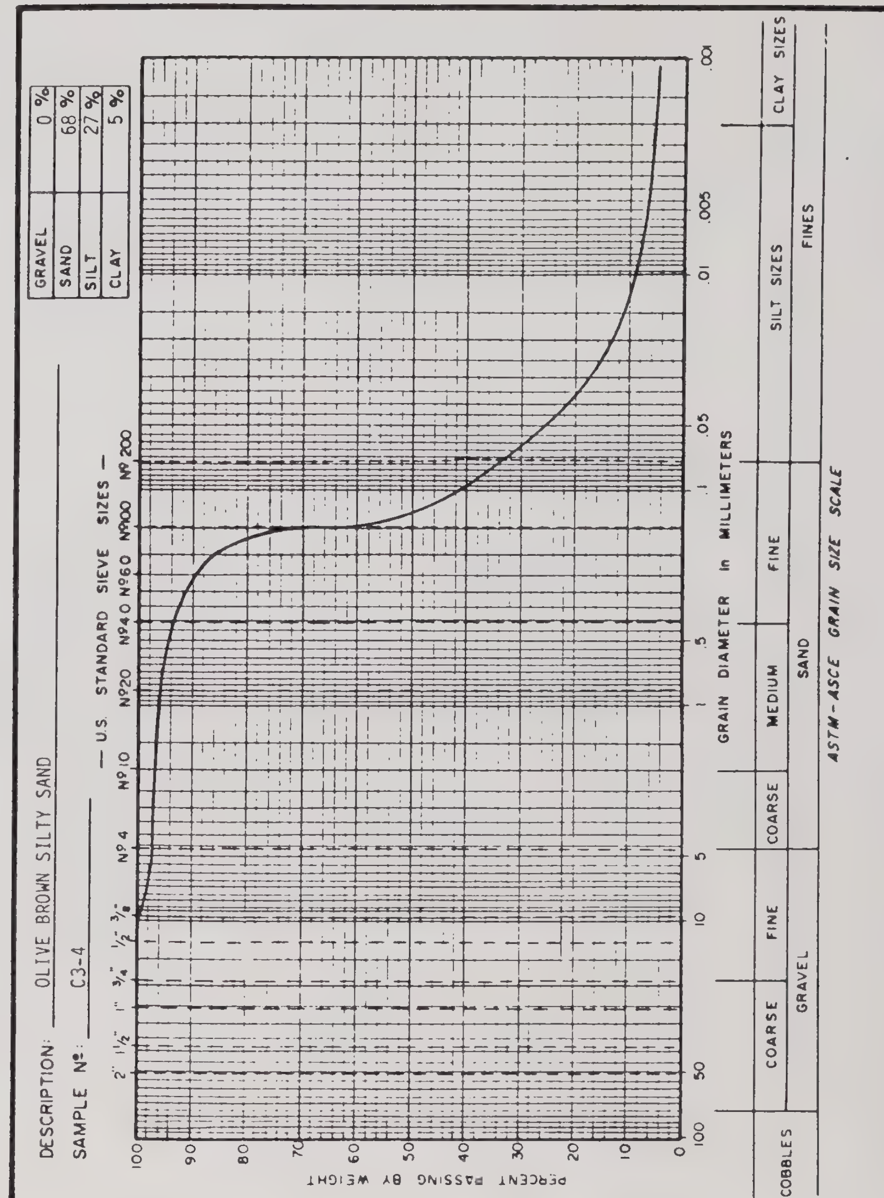


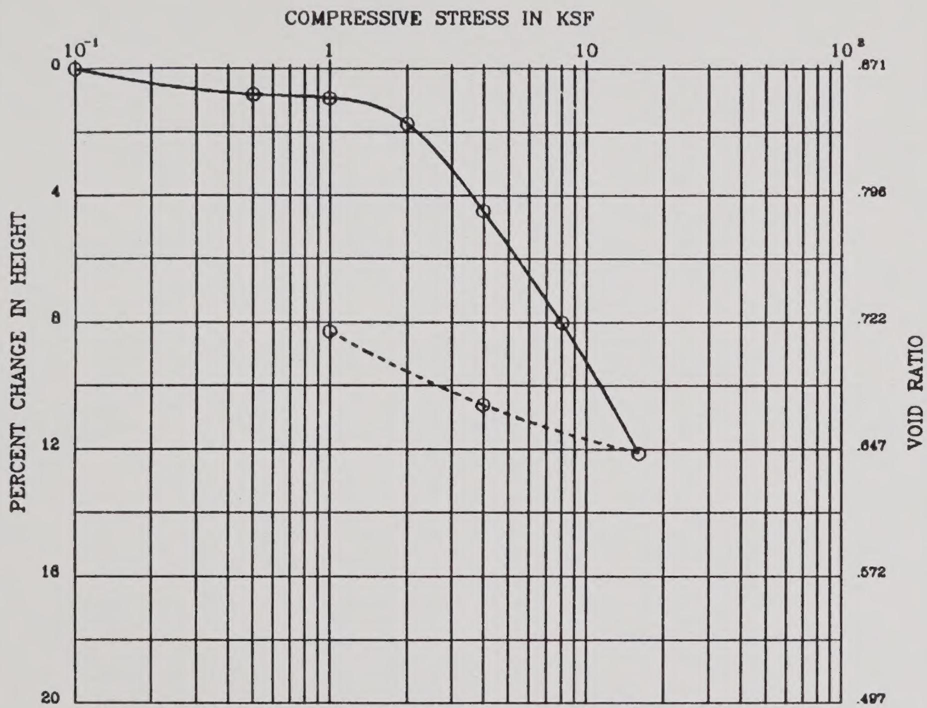


SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	2-7	33			POORLY-GRADED SAND W/ GRAVEL (SM)

Remark : dk gry,blk ol, well graded SAND w/ gravel

C6-2280-C1	
Earth Systems	GRAIN SIZE DISTRIBUTION





BORING : 2-4
DEPTH (ft) : 19'
SPEC. GRAVITY : 2.82

DESCRIPTION : Fat clay w/minor sand (CH)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	29.9	94.2	97	.871
FINAL	25.3	102.7	100	.716

Remark : very dark gray, moist medium stiff

C6-2280-C1	
Earth Systems	CONSOLIDATION TEST